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A POOL IN THE NEW FOREST.
From the Painting by A. C. Wyatt.

THE WAVERLEY
NATURE BOOK

A POPULAR DESCRIPTION BY PEN AND CAMERA OF THE DELIGHTS AND BEAUTIES OF THE OPEN AIR

VOLUME II

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HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

With Photographs by
RICHARD AND CHERRY KEARTON

STARLINGS AND CROWS

WITH the hard and close-feathered Starling we get to a bird beyond the average *Passerine* size and approaching the Crows in shade and make. It brings itself continually under our notice in town and country by chattering from our chimney pots, breeding under our tiles, or industriously searching our grass plots for noxious grubs. A beautiful bird is the spring-time Starling, and cheery besides, as with crown feathers erect, drooping, quivering wings, and metallic-lustred plumage, he whistles, chatters, and sings—even in mid-winter should the sun be shining—mimicking meanwhile the strains of many other birds that are then silent.

The black body-colour is radiated with glossy green and purple reflections, each feather of the upper plumage being star-tipped with cream colour. As with the Blackbird, Swan, and other less well-known birds, the depth and clearness of colour in the Starling's beak varies with the season; the sexes when adult are almost equally bedecked with glossy sheen, but the young birds in first plumage are clad in sombre ashy brown, in which garb they assemble on the meadows and marshes by the middle of June, young and old congregating in vast flocks as the season advances. In the autumn the weight of their numbers roosting upon the reeds around our Broads plays havoc with the marshman's winter harvest,

MALE STARLING.

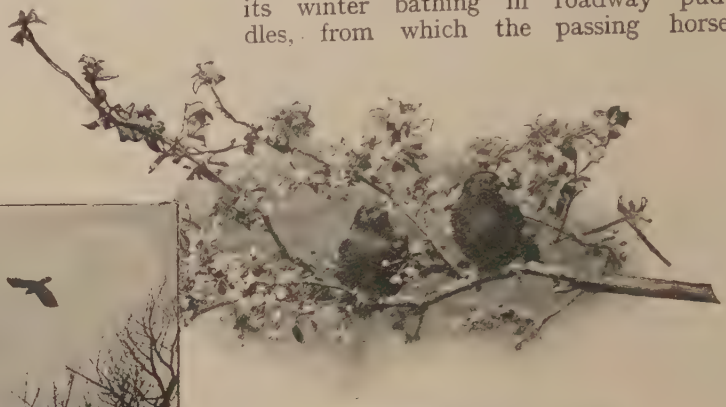
FEMALE STARLING.

and later on, when thousands betake themselves to perch amongst the evergreen plantations, their presence is generally voted a nuisance, not so much on account of the babble of their chatterings as of the pestilential perfume of their droppings. Some compensation for the nuisance and damage caused by their nightly numbers is to be gained from watching their

ROOKS' NESTS.

marvellous evening aerial evolutions, which are continued for some half-hour ere sunset, above and around their much-fought-for perching places.

Perhaps the most distinctive habit of the Starling, however, so far as the roadside naturalist is concerned, is the beneficent service performed by it to the fleecy flock. The larger Jackdaw and Magpie upon occasions also act as sanitary inspectors of living cattle, but should a bird about the size of a Thrush be seen demurely perched upon the broad back of a complacently reclining or grazing sheep it may be taken as practically certain that the bird is a Starling, intent upon ridding the sheep of unwelcome guests. It is, perhaps, prompted thereto by the proverbial fellow-feeling, for the Starling itself is a prey to insect parasites, to which fact may be accounted its winter bathing in roadway puddles, from which the passing horse



YOUNG CARRION CROWS.

hoofs have partly removed the icy covering.

The initial difficulty in dealing with the Crow family is to differentiate between a Rook and a Crow. The Hooded or Grey Crow—specially partial to the neighbourhood of the sea-coast, upon which it delights to scavenge—is easily to be distinguished from its cousins by its costume, but the Black or Carrion Crow so closely resembles the Rook in many respects that the two are often confounded. In the hand the two species may at once be identified by turning back the body feathers, when it will be seen that their bases in the Crow are a dull white, whilst in the Rook they are dark grey. The adult Rook has the space between the eyes and beak white, warty and bare of feathers, whilst in both Black and Hooded Crow it is covered with bristly feathers. The two Crows are rather larger and heavier-looking birds, and with harsher voices than the Rook, and they are rather solitary than gregarious in their habits, especially in the breeding season; they never build in colonies as do the Rooks. In strictly corn-growing districts the latter birds entirely disappear from June until harvest time, taking their young to the grass lands where worms and the larvæ

of Click Beetles (wireworms), Daddy Long-legs, and Cockchafers are come-at-able. In autumn, where oaks abound, Rooks may often be seen plundering the trees of acorns; they are equally partial to walnuts, and where potatoes are grown as a field crop they are apt to levy toll upon the tubers.

Both Rooks and Crows are terrible egg thieves, but the former are not so destructive to the young of other birds and animals as are the Carrion Crows, which I have known to attack young lambs, and the neat way in which both they and Grey Crows will turn the skins of rats and rabbits inside out in order to pick the bones is surprising.

At a distance the Jackdaw is much like a Grey Crow in miniature so far as plumage is concerned, but on closer inspection the black and the grey feathering will be found to be not quite similar either in tone of colour, or in distribution about the body. The smaller bird has the iris white instead of dark hazel, and Jack's note will soon betray his species, for the Daw is a proverbially loquacious bird.

Rooks, Crows, and Jackdaws are all fond of gyrating—sweeping, circling, and tumbling about in the air, especially on still autumnal days; though when these manœuvres are indulged in they are said (sometimes of course rightly) to presage stormy weather.

CARRION CROW'S NEST, WITH YOUNG.

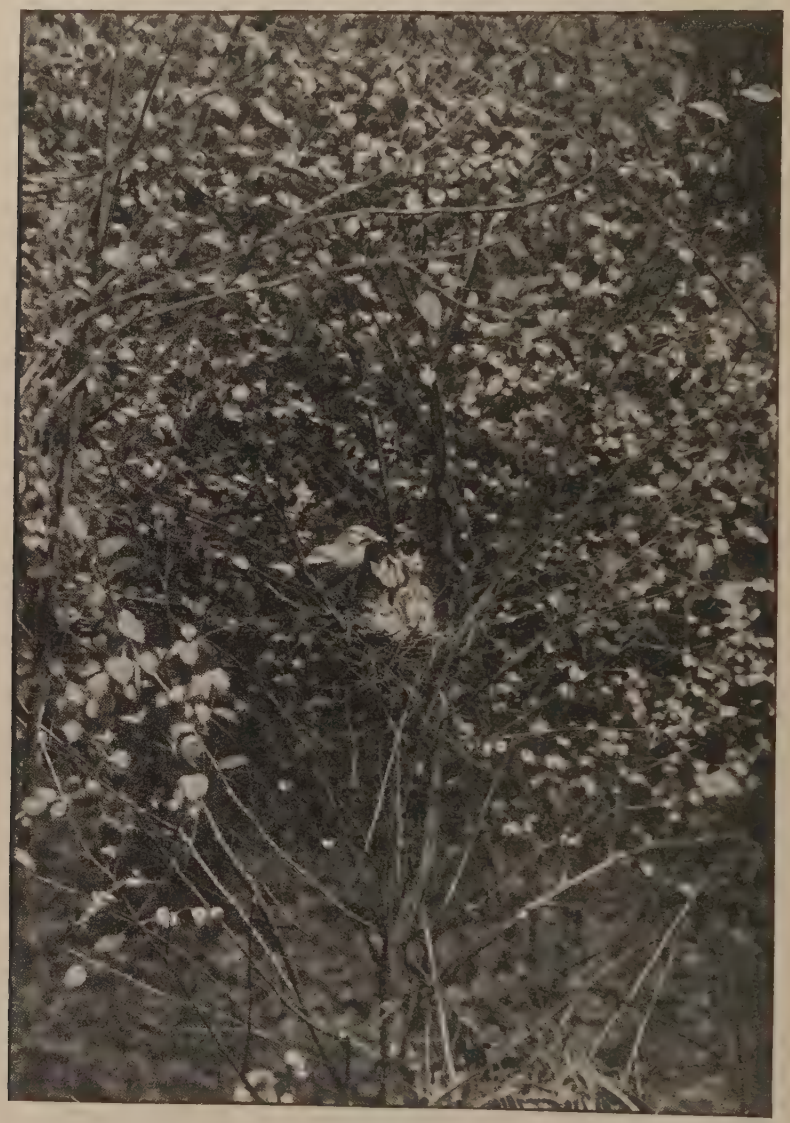
In October numerous Crow birds may be seen trooping over from the Continent for many days together. On their arrival on our eastern coast they leisurely work their way inland, flying low down meanwhile.

The long-tailed black and white Magpie needs no further description, as it cannot be mistaken for any other bird. It is sly and crafty to a degree, and is never allowed to multiply in game-preserving

districts because of its egg-thieving propensities. Next, perhaps, to its strongly contrasted colours, the most striking peculiarity in connection with the Magpie is the monstrously long hops by which it

of thorny sticks, whereas the Jackdaw usually builds in holes of trees, masonry, or sea-cliffs, and, though rarely, in rabbit burrows.

The eggs of the Jackdaw assimilate to



A JAY FEEDING HER NESTLINGS.

seems able to progress on the ground with a minimum of apparent exertion.

Whilst Rooks and Crows build large and clumsy open nests, the Magpie covers its deeper-cupped nursery with a dome

those of the rest of the Crow family, in that they are of a pale blue ground-colour, but spotted and blotched rather than streaked with superimposed (almost black) markings. Now it is very unusual

for birds breeding in holes to lay such highly coloured eggs, and the fact that the Jackdaw does so is accounted for by the supposition that it is in a transition stage so far as nidification is

JACKDAW.

concerned, a suggestion which is supported by the fact that both domed and open nests built in trees by this species have been found.

The Jay, with erectile crest, black moustaches, pale vinous brown body feathers, black and white wings, and black tail, is more strictly a bird of the woods than any other representative of the Crow family. It seldom shows itself in the open, and as infrequently allows a sufficiently near approach for the beauty of its lovely black-barred, azure blue wing patch to be duly admired. At the slightest alarm, with or without a harsh scream, it hurries off with wavy flight, exposing to view meanwhile the white rump and upper tail coverts which may act as a flag to be followed by all the less wideawake Jays in the neighbourhood.

Jays are very inquisitive, and by trading upon this very human trait in their characters, these handsome but wary birds may easily be studied at close quarters. A kitten (the lighter in colour it is the better) should be taken into their plantation home, tied up in a clear place under the trees and there left; the observer should then conceal himself amongst the surrounding brushwood and watch for developments. When pussie begins to mew for company, the Jays will soon arrive to inspect and talk over the little stranger, showing themselves off meanwhile to great advantage.

Inimical as the Crow birds doubtless are to the interests of gamekeepers for a month or two in the year, they also act as useful alarums when other poachers, biped or quadruped, are on the prowl.

YOUNG JACKDAW.

Thus the alert and garrulous Jays are all on the chatter so soon as the preserves, which they inhabit on sufferance, are invaded by strangers in daylight, whilst the restless Rooks are sure to give noisy notice of trespassers by night in the coverts where they roost.

MAURICE C. H. BIRD.

THE LIFE OF THE SEA-SHORE

By F. MARTIN DUNCAN, F.R.P.S.

Illustrated with Photographs by the Author

THE SHELL-DWELLERS

"See what a lovely shell,
Small and fine as a pearl,
* * * *
Frail, but of force to withstand,
Year upon year, the shock
Of cataract seas that snap
The three-decker's oaken spine
Athwart the ledges of rock."

TENNYSON'S exquisite lines are vividly recalled to us as we stoop to pick up a frail, daintily shaped and tinted shell cast up at our feet by an incoming wave. So fragile, and yet so wonderfully built that it can withstand the rough tumbling of the surf. The shell-dwellers form a very important portion of the life of the sea-shore; and whether we only examine the beautiful shell-dwellings, or watch them when attached to the curious inhabitants responsible for their construction, they are of the greatest interest and beauty. As we look through drawer after drawer of a collection of shells, though their beauty of form and colour arrests our attention and calls forth our admiration, we can learn but little of the why and wherefore of those varied shapes, or of the animals of which they once formed a part. If we are true lovers of Nature, the sight of these shells sets us longing to be down on the sea-shore, wandering over the golden sands, and peering into the depths of the rock pools, striving to find out what the creatures that form these wonderful dwellings are like.

"Did he stand at the diamond door
Of his house in a rainbow frill?
Did he push, when he was uncurl'd,
A golden foot or a fairy horn
Thro' his dim Water-world?"

THE PECTAN, OR SCALLOP.

All round our coasts the shell-dwellers abound, so that when on a visit to the sea-shore, one cannot fail to meet with specimens. Some, like the Oysters and Mussels, lead a sedentary life, while others lead a more or less active existence, crawling over the rocks and weeds, or burrowing in the sand. One of the largest of our shell-dwellers, although not strictly belonging to the sea-shore, but rather to the region beyond low-tide mark, is the Common Scallop, or Pectan. Its shell, however, is a very familiar sea-shore object, cast up by the waves after a storm, and frequently having upon its upper surface a luxuriant growth of Garland Polypes, Moss-animals, etc. The shell of the Scallop is composed of two parts, or valves, quite dissimilar to each other in appear-

ance, one being flat, the other convex. The animal itself is a remarkable creature, and has a very curious method of

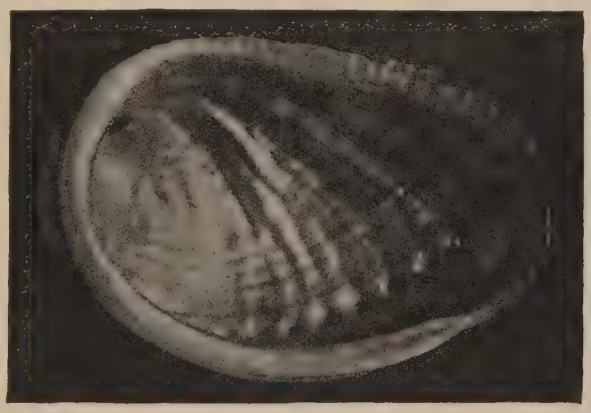
PECTAN OR SCALLOP SHELL, WITH ACORN BARNACLES ATTACHED.

locomotion, for when it wishes to travel it smartly opens and closes the valves of its shell, thereby causing a rapid expulsion of water, which drives it backwards. The Scallop is a veritable Argus as regards eyes, possessing somewhere between sixty and seventy. These numerous eyes, moreover, are well-developed organs, and are arranged in a double row, like brilliant, tiny, green beads, upon the edges of the fleshy envelope or "mantle" that encloses the body of the Scallop.

The Queen Scallop is smaller, and differs considerably in general appearance from the Common Scallop, both the valves of its shell being convex and more firmly convoluted. A small Scallop, called *Pectan varius*, is well worth hunting for, on account of the beautiful form and colour of its shell, the latter being very varied, from pure white to a fine red-brown.

A handsome and interesting shell-dweller is the Solen, or Razor-shell, which has gained its popular name from the shape of the two valves of its shell, which united along one edge somewhat resemble a razor-case. These valves have a highly polished outer surface, marked with beautiful gradations of orange, brown, green, and purple colours; while within they are an exquisite pearly-white, through which the outer markings show. The valves are thin, and bent to form a cylinder open at each end. The Solen lives in the sand near low-tide mark, at a varying depth of a few inches to a couple of feet or more, in an upright position, and its presence may be detected by little hollows, somewhat resembling keyholes, in the sand. If we carefully watch one of these openings, and make a gentle movement on the surface of the sand near to it, we shall see a little jet of water thrown out from time to time. The fishermen, who use the Solen for bait, watch for the little jet of water, and at once plunge a barbed iron wire into the sand at the spot from which the jet issued, and generally succeed in impaling the unfortunate mollusc.

A simple method of obtaining an uninjured specimen for examination is to sprinkle a small quantity of salt upon the holes in the sand. The salt soon penetrates down the hole, and reaches and irritates the ends of the tubes or syphons of the animal, causing it immediately to rise in the sand. The

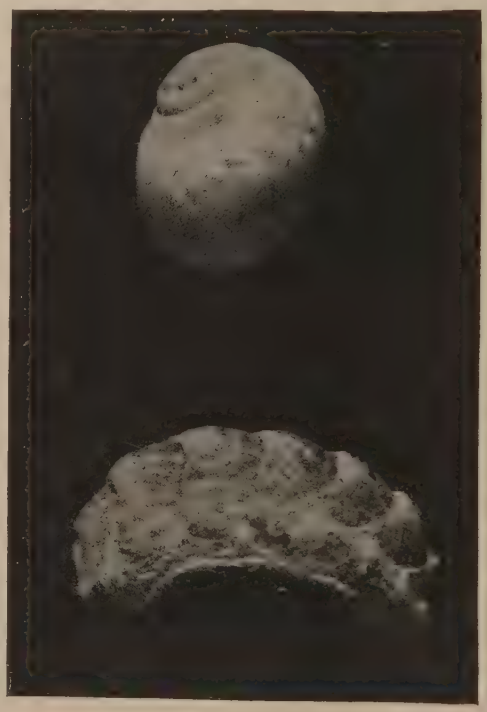


THE ORMER (INNER SURFACE OF SHELL).

moment it appears at the surface the Solen must be swiftly seized, for if alarmed it will dart back into its burrow, and then no amount of salt or

anything else will induce it to come out again.

If we are lucky, and capture the Solen, we may witness the remarkable and rapid manner in which the creature burrows. On being placed on the sand, the Solen at once protrudes a flat-shaped foot which ends in a point. It then with ease proceeds to drive this singular organ into the sand, and bending the pointed end into the shape of a hook, acquires a sufficient hold to drag the cylindrical shell into an upright position. The foot is then unbent, elongated, and again forced downwards to a depth of one-half to two-thirds of the length of the shell, and then the foot completely changes its shape. Without diminishing in length, it becomes cylindrical, swelling out near its extremity into a fleshy globe, which becomes securely embedded in the sand. Then by shortening that portion of the foot which is situated between the globular swelling and the shell, the latter is drawn downwards, and this process, being rapidly repeated, the creature buries itself with astonishing velocity.



1. NATICA, OR SEA SNAIL.
2. THE CHITON, OR ARMADILLO-SHELL.

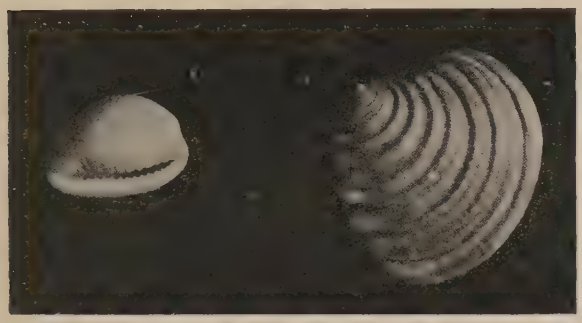
On all rocky shores the Limpets abound, and this in spite of many foes. On a lonely stretch of rock-strewn shore one may watch one of the sea birds, called the Oyster Catcher, at work, knocking the Limpets off the rocks by sudden, well-directed blows of its punch-shaped bill, and then scooping out and devouring with evident relish the fleshy parts of the unfortunate shell-dwellers. Another foe of the Limpet is the Dog-whelk, which lives on the shore from close to high-water mark down to and beyond low-water mark. If we look about carefully amongst the rocks we are pretty sure to find a Dog-whelk perched upon a Limpet, engaged in the process of drilling a neat hole through the shell of its unfortunate and helpless victim. When the Dog-whelk wants a meal, it climbs up on to the crown of the Limpet shell, and with the aid of its file-like tongue proceeds to rasp a hole through the shell, and then inserting its protrusile mouth, literally eats the Limpet out of house and home.

Though of humble exterior, the Limpet is in its way a really remarkable creature. The tenacity with which it clings to the rock upon which it is resting is proverbial, and experiments have proved that it takes about a seventy-pound pull to dislodge a fair-sized Limpet when once the creature has got a firm hold. Inside its mouth it has a long, ribbon-shaped organ, called the radula, or tongue, which has many teeth upon its surface, and is used by the Limpet with a rasping movement when feeding. There are about 160 rows of teeth on this curious tongue, and as each row has twelve teeth, the Limpet has about 1,920 teeth in all.

The familiar Periwinkle is also the possessor of a remarkably long tongue, furnished with some 500 to 600 rows of teeth, and it is with this wonderful organ that the Periwinkle rasps away at the seaweeds which form its staple diet.

Frequently to be met with on the rocks at low water is a curious shell-dweller,

which looks rather like a long, flat Limpet, but on closer inspection is seen to have its shell arranged in eight pieces or bands across its back. This is the Chiton, and



COWRIE AND VENUS SHELLS.

when detached from the rock the creature has a curious habit of rolling itself up like an armadillo, so that it is sometimes known as the Armadillo-shell. The eight divisions of the shell are so arranged that the pointed posterior edge of each overlaps the one behind.

The large and handsome Ormer (*Haliotis tuberculata*) abounds on the shores of the Channel Islands, and full-grown specimens measure about four inches in length by three inches in breadth. Its beautiful iridescent shell is frequently to be seen in seaside "curio" shops, and is one of the delights of every collector.

The Sting or Rock Winkle, like the Dog-whelk, preys upon its fellow shell-dwellers, and frequents the pools near low-tide mark and the deeper water beyond. It is one of the many foes of the Oyster fisherman, for it delights to drill a hole through the shell of the Oyster and regale itself upon that succulent mollusc. In the time of the Romans a beautiful purple dye was obtained from a species of Rock Winkle, the small shells being bruised in a mortar; and on the Tyrian shore and the coast of Morea large heaps of these crushed shells, together with the old rough stone mortars, are still to be seen.

"Devour and be devoured" is very much the order of life amongst the shell-dwellers, and the pretty little sea-snail Natica is no exception to the rule. Feeding largely upon small Mussels and similar molluscs, the Natica is in turn greedily devoured by the Cod and Haddock.

The Cockle, which frequents sandy, gravelly shores, is a great gymnast, for by smartly projecting its foot against the ground it can leap a distance of five or six yards. Where Cockles abound an extraordinary sight may be witnessed as the tide begins to rise, for then the Cockles, which have been safely hiding in the sand, emerge in large numbers and begin to leap down the shore towards the incoming tide. The Prickly Cockle (*Cardium echinatum*) is well worth seeking for its handsome shell. It is a cousin of the Common Cockle, and is to be found in similar situations on the shore.

A shell-dweller that has an almost world-wide distribution is the *Trochus*, or, to give it its two popular names, the Hoop or Top shell. The animal lives in the pools at about low-water mark, and has a very handsome pyramidal-shaped shell, with a nearly flat base.

The beautiful, lustrous white Ladder-

THE PRICKLY COCKLE.

shell, or Wentle-trap, is another shell-dweller that frequents the rock pools at low-tide mark. The delicate spiral shell is turreted and many-whorled, and is further ornamented with numerous transverse ribs. A living specimen should

always be handled with care, as the animal, when angered or molested, has a habit of discharging a purple staining fluid.

LADDER-SHELL, OR WENTLE-TRAP.

The Scaphander, or Boat-shell, is a carnivorous shell-dweller that delights to feed upon the inhabitants of the slender, tubular-shaped Tooth-shells. It is rather a handsome creature, with an oblong convoluted shell, and is the proud possessor of a remarkable and somewhat complicated shelly gizzard. It frequents sandy ground from about low-water mark to a depth of fifty fathoms.

On rock-strewn shores, seeking the shelter of the overhanging rocks in the pools, we may find the pretty little Cowrie (*Cypræa Europea*), a type of a family of shell-dwellers comprising some 150 species, with an almost world-wide distribution, which attain their greatest size and beauty in tropical seas; they are represented in past geological formations by about 84 species. The Asiatic Islanders use a Cowrie (*Cypræa annulus*) to adorn their person, threading the shells so as to form elaborate necklets, and also use it for purposes of barter. The Money Cowrie (*Cypræa moneta*) is used in barter very largely by the islanders in the Pacific and Eastern seas, though not to the same degree as in the early days of their commercial relationships with European traders.

To give anything like a detailed description of all the shell-dwellers that frequent our shores and tidal pools would fill half a dozen portly tomes, and therefore the above brief account of some of the more striking or familiar forms must suffice. Their wonderful deep-water-loving cousins, the Octopus and Cuttlefish, I have very fully described in my book on the "Denizens of the Deep." There are, however, two most interesting molluscs, frequenters of our tidal pools, which we most certainly should try to find during our rambles along the shore; one of them is called the Sea-Hare, and has only a rudimentary shell; and the other, the pretty little Doris or Sea-Lemon, has no shell at all.

The Sea-Hare represents a transitional type between the true shell-dwellers and their shell-less cousins, and has quite a rudimentary, oblong, translucent shell, which is partly hidden in the folds of the large fleshy lobes down each side of the body. It is a strange-looking animal, rather slug-like, with a long neck, and has four tentacles upon its head, the dorsal pair somewhat resembling the ears of a hare. It is from these ear-like tentacles that the creature has gained its popular name. Formerly, the Sea-Hare, on account of its grotesque shape and the purple fluid which it discharges when alarmed or

THE BOAT-SHELL WITH ITS CURIOUS SHELLY GIZZARD-PLATES.

irritated, was an object of much superstitious dread, for the fluid was believed to be a deadly poison and to produce indelible stains. This old-world myth is

perpetuated in the Latin name of the Sea-Hare, *Aplysia*, which literally means unwashable. Although a perfectly harmless creature, it is advisable to handle a living Sea-Hare with caution, for not only does the animal discharge its purple fluid, but also may have a pungent odour, which is very difficult to remove from the hands.

The Doris has no shell at all. It is a pretty little oval creature, and is in shape and colour somewhat like a lemon that has been cut in half lengthwise. It is from this appearance that the little animal has gained its popular name of Sea-Lemon; its Latin name, *Doris*, meaning a sea-nymph. The Doris is to be found on most rocky coasts, crawling over the rocks near low-tide mark, and is one of the very few animals that feed upon the sponges. So fond is it of devouring sponges, that on cutting a Doris open one is pretty sure to find its stomach crammed with sponge spicules, the absolutely indigestible portion of the sponges. During the summer months curious, whitish, gelatinous rosettes, some two inches in diameter, may be seen fixed in a rather conspicuous manner on the rocks in the tidal pools. The gelatinous ribbon of the rosette is divided into tiny spherical sacs, each containing four or five eggs of the Doris. If we examine under the microscope a portion of one of these rosettes when the young are just hatched, a very remarkable scene is presented to our view, for within each sac four or five young Dorids, each partially enclosed in a beautiful, transparent, Nautilus-shaped shell, may be seen swimming actively round and round. The presence of this transparent shell, covering the young Doris, is very remarkable, and interesting, for it shows us that the now shell-less adult Doris has descended from shell-bearing ancestors, and was in some past age probably a true shell-dweller.

F. Martin Duncan.

THE HOOP OR TOP SHELL

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.
With Photographs by HENRY IRVING

THE FLOWERS OF THE WATER-SIDE—II

YELLOW LOOSESTRIFE

THE Great Yellow Loosestrife (*Lysimachia vulgaris*) is an erect growing plant, between two and three feet high, which is found in moist, shady places. At intervals up the stem, three or four leaves spring, arranged in a whorl, and the yellow flowers grow both from the axils of the upper leaves and at the termination of the stems, forming a leafy panicle. The calyx has five teeth, while the corolla also has five divisions, but, like the Primrose, the petals are not separate; the number of stamens correspond with the number of divisions of the

GREAT YELLOW LOOSESTRIFE.

BOG ASPHODEL.

corolla. These are some of the features which place the plant among the *Primulaceæ* (the Primrose family). The name Loosestrife is a translation of the word *Lysimachia*. Pliny states that the name was given in honour of a certain king *Lysimachus*, and he also adds that if the plant be laid on a yoke of oxen, when they are quarrelling, it will quiet them and stop the strife!

BOG ASPHODEL

The Bog Asphodel (*Narthecium ossifragum*) is a member of the Lily family, and will be readily recognised by its stiff, erect flowering stem, about six or eight inches high, bearing at the end a cluster of bright yellow flowers. There are six divisions of the perianth, all of them looking like petals, six stamens, and a single pistil. The little stems of the stamens, called filaments, are covered with white, woolly hairs; the leaves are short and grow near the base of the plant. This little plant is found abundantly in most boggy places, and flowers during the summer.

WATER MINT

The Water Mint (*Mentha aquatica*) is a plant which possesses a strong scent, by which it may readily be recognised. This plant is generally found growing in shallow water, sending up soft, hairy stems about a foot high, ending in a more or less globular head of lilac flowers; a few other heads also appear from the axils of the upper leaves. If

WATER MINT.

one of the flowers be examined, it will be found to have the same shape as the flower of the Dead Nettle or the Ground Ivy; that is to say, that the portions of the corolla form two lips. All these plants are included in the family of *Labiatæ*. There are five teeth in the calyx, which is also slightly two-lipped; four stamens, all of the same size, will also be found.

The Corn Mint (*Mentha arvenis*) is very similar in appearance, and almost as common, but is found growing in fields. Both species flower during the summer and autumn.

THE ARROW-HEAD.

ARROW-HEAD

The Arrow-head (*Sagittaria sagittifolia*) is a member of the same family as the Water Plantain (*Alismaceæ*), but it differs very much in one respect; inasmuch as the Water Plantain bears both the stamens, and stigmas with seed bearing carpels in the same flower, the Arrow-head bears two distinct kinds of flowers, the upper ones being the males, bearing stamens, and the lower ones the females, possessing the future seed vessels; the latter will be seen to be more shortly stalked than the former.

The leaves are very distinctly shaped in the form of an arrow-head, and rise from the water on long stalks; the three inner portions of the perianth are white with a purple mark at the base, and much longer than the three outer green ones. The flowering time extends through the summer and early autumn.

H. Purefoy FitzGerald

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," etc.

THE SHORT-TAILED MEADOW MOUSE—II

SHORT-TAILED FIELD MOUSE. FIELD VOLE. COMMON VOLE.

With Photographs by the Author

HAVING marked down the particular community of Meadow Mice referred to in my previous article, and not being aware of the existence of any other in the immediate neighbourhood, I endeavoured to trap some of the mice alive. In this I was completely unsuccessful. I tried the ordinary mouse-traps, drop-traps of several standard kinds, small pitfall traps, traps of my own devising, and even springes to entangle their feet. I tried every bait which was known to me, and several new ones by way of experiment. Everything failed.

SHORT-TAILED MEADOW MOUSE.

It is curious that no really effective bait for these mice, or "safe" means of poisoning them wholesale, has yet been discovered. In "Geoponica," a compilation of Greek papers on Agriculture, which dates from about 920 A.D., I find the following; "Apuleius suggests smearing the seed with ox-gall and the mice will not touch it, but it is better to get some hemlock seed in the dog-days, and mince it up with hellebore and meal, or to mince together wild cucumber, or henbane, or bitter almond, and black hellebore, mix it with equal parts of meal, make a paste of it with oil, and put it in their holes. Tasting, they die. In Bithynia practical farmers stop their holes with rhododendron leaves, so that the mice, rushing out of the holes, seize the leaves with their teeth. Seizing, they perish." The writer here breaks off suddenly and proceeds with almost vicious abruptness: "Take paper and write as follows — *I adjure you mice that are found here, do me no harm, nor suffer another mouse to do me harm, for I give you this field* (here insert details of the field). *If I catch any of you here after this, when I get you, by the Mother of the Gods, I will cut each of you into seven parts.*

"When you have written this, glue the paper, before sunrise, to some stone in the field where the mice are, and be sure that the writing faces outwards. I have included this in case it might appear that I had left anything out. I don't accept everything of this kind myself, heaven forbid! And I recommend any one who does not wish to be made a fool of to follow my example."

A millenium has not advanced us much. During the plague in Thessaly in 1892, steps were taken to procure, on the one hand, holy water from Mecca, and, on

the other, some up-to-date virus from Berlin.

Eventually I caught two of the Meadow Mice in my hands. One, quite a young

A TYPICAL MEADOW MOUSE'S SURFACE RUN OPENED WITH THE FINGERS AND VIEWED FROM ABOVE.

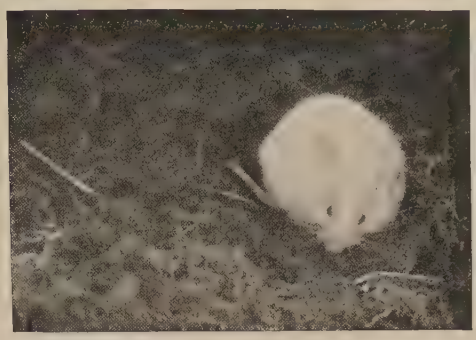
The run started from the hedgerow and went twenty yards into the field. Several culs-de-sac can be seen.

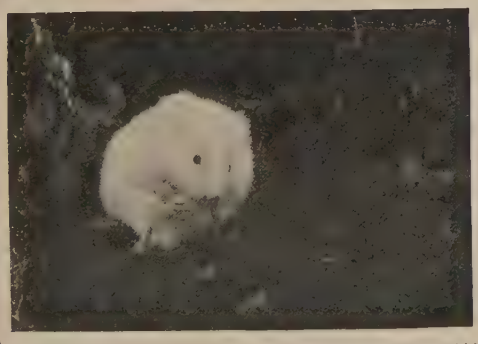
one, I secured while he was snaking in the grass farther from home than he should have been. The other I judge to have been the head of the clan. His capture was less orthodox. I had been standing quietly over the stump and suddenly caught sight of his eyes. Something had occurred to prevent his reaching either of the shafts. He had, therefore, flattened himself against the wood about six inches from safety, and was staring backwards over the top of his head, just as a Water Rat does when it hopes you have not seen it, but at the same time wishes to keep an eye on you. He harmonised so neatly with his surroundings that it was mere chance which enabled me to sight him. As I caught him he bit me rather severely, and he continued spiteful until I released him.

The growth of the hay put a stop to my direct observations of these mice, but I had had time to determine several of their characteristic attitudes, which are reproduced in the illustrations in this and the previous article. As soon as the hay was cut I had the curiosity to investigate their runs more closely. None of these could fairly be termed subterranean, though some had been deepened by wear slightly below ground level. In several instances there were small blind sidings from the main track, reminding one of the surface runs of the Mole, and perhaps similarly constructed with a view to wayside refreshment.

I have found that, where a colony of Meadow Mice has fairly established itself, there is a tendency for the runs to be slightly deeper and to present an arched roof *above* ground level, which consists of soil lightly held together by root fibres from the adjoining grass. Such runs can be traced by the simple expedient of running two fingers along them, and their characteristic appearance can be seen in the accompanying illustration.

It would be hardly reasonable to compare such normal conditions as the foregoing with the abnormal conditions prevalent during a Mouse plague, but I think that, slight as my observations have been, they may help us to the conclusion that, given a quick-breeding mouse of this kind, with a simple, indiscriminate taste in vegetable food, a strong inclination to feed under cover, a corresponding disinclination to roam afield, and a modicum of low cunning, it needs little more than an unusually rich combination of food and cover to make him multiply exceedingly, and spread, slowly at first, but with increasing speed as his numbers increase, from exhausted districts to those





A PURE ALBINO SHORT-TAILED MEADOW MOUSE.

Among the millions of this species which have come directly under human observation less than half a dozen examples of albinism, complete or partial, have been recorded. These photographs may therefore be fairly regarded as photographs of one of the rarest animals known.

more favourable. He will only be checked when cover fails him, and it would appear to be Nature's design that he himself should be responsible for the failure of cover. Once he has abandoned the marshland he has broken the law of the wild, and his extermination is dependent solely on the speed with which his furred and feathered enemies can assemble.

PHOTO-MICROGRAPHS OF THE GRINDING SURFACES OF THE LEFT UPPER AND LOWER MOLAR TEETH OF

(1) The Long-tailed Field Mouse: bunodont type.
(2) The Red-backed Meadow Mouse. Teeth rooted. Prismatic spaces 5, 4, 5; 7, 3, 3.
(3) The Short-tailed Meadow Mouse. Teeth not rooted. Prismatic spaces 5, 5, 6; 7, 5, 3.

The most obvious adaptations of the Meadow Mouse to his marshy surroundings are to be seen in his fur and in his grinding teeth.

In a previous article I referred to the peculiarities of the incisors (front teeth) of Rodents. The entire absence of canines (dog teeth) is characteristic of the order, and between the incisors and the molars (grinding teeth at the back) there is a toothless gap which is termed the diastema. In many instances the furred borders of the lips curl in so as partially to fill this gap, and it has been suggested that this fur insertion may save the animal the discomfort of swallowing material which it intends merely to gnaw.

Some such provision would be almost essential to the true Mice, and to the Red-backed Meadow Mouse, while even the Short-tailed Meadow Mouse may, on occasion, gnaw without the wish to feed; in dressing his own fur, for instance, or in nest-building.

It may be mentioned that in nest-building, Meadow Mice construct the soft lining of their nests by biting grass stems into short lengths of an inch or less. They soften these short lengths by pulling them between their teeth, and, as the grass has a tendency to split apart in this process, they can deal with a large mass of material in a very short time.

If reference be made to the illustrations on this page, it will be seen that the molar teeth of mice (they have three molars on each side of their upper and lower jaws) present peculiar and somewhat intricate patterns. The type of molar found in the true Mice is shown in Fig. 1; that of the Red-backed Meadow Mouse in Fig. 2, and that of the Short-tailed Meadow Mouse in Fig. 3. It will be seen that the first type differs materially from the other two. In this "bunodont" type of dentition (which we ourselves possess) the grinding surface of each tooth consists of several small hillocks of enamel arranged in more or less parallel rows—three rows in this case of the upper teeth, and two of the lower. Such teeth are adapted for masticating fish, flesh, fowl, or good red herring, and, of course, any kind of soft vegetable in addition. In the Meadow Mice the molars are far more highly specialised. Their surfaces present a zigzag series of rough triangles. The sides

of these triangles are formed by ridges of hard enamel, while the " prismatic spaces " enclosed within the sides consist of soft ivory, which, besides maintaining the shape of the tooth, is probably resilient enough to serve as a cushion for the more brittle enamel. The ivory naturally wears hollow, and it is obvious that, when the lower jaw works quickly back and forward, a number of cutting edges are simultaneously brought into play, with the effect of a mincing and grinding machine combined. No better form of tooth could be imagined for dealing quickly with rough marsh-land vegetation.

Considerable importance is attached to the *number* of the prismatic spaces as a means of distinguishing one species of Meadow Mouse from another, and if the spaces always composed themselves into figures which might reasonably be called distinct triangles, or indeed distinct anything, this canon would be practically as well as theoretically useful. The difficulty, however, of defining a " prismatic space " is shown by the fact that, whereas Continental naturalists appear to recognise as many prismatic spaces as possible, English naturalists appear to recognise as few prismatic spaces as possible. In the case of the lower jaw of the Short-tailed Meadow Mouse, for example, French reckoning gives the number of prismatic spaces in the three teeth as 9, 5, 3, whereas English reckoning gives them as 7, 5, 3.

It would be expected that an animal whose normal habitat was damp would be coated with a fur which would tend to throw off water; a fur, that is, which, apart from any natural oiliness, would be mainly composed of fine hairs set closely together, and without pronounced spear-tips.

This is unquestionably the case with the Short-tailed Meadow Mouse and his near relation, the Orkney Meadow Mouse, whereas in the case of the Red-backed Meadow Mouse and the true Mice generally, the tendency for each hair to become spear-tipped is marked. This tendency is accompanied by a redder coloration, owing to the fact that the pigment cells, which, for the greater part of the hair's length, are arranged in a single row, tend, in the spear-tip portion, to break up and diffuse their pigment. Measured under the microscope, the average width of the thickest portions of the hairs of the four species works out as follows :—

Orkney Meadow Mouse	·018 mm.
Short-tailed Meadow Mouse	·026 mm.
Red-backed Meadow Mouse	·052 mm.
Long-tailed Field Mouse	·045 mm.

The result of the fineness of the hair in the first two species, with which is associated a brown rather than a red coloration, is that the individual hairs lie close to one another almost to the tips, and thus form a covering which is impervious to ordinary moisture.

THE ORKNEY MEADOW MOUSE.
Distinguished by its larger and heavier build, shorter relative length of tail, blunter muzzle, and finer hairs.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE ALDER AND THE HAZEL

THE Alder is the guardian of the water-meadows. Its matted roots bind the river banks against erosion; its ranked stems march with the stream; its deep green, glistening, and long-lasting foliage provides long succession of cool retreats by shaded pools. Occasionally it may be found standing back somewhat, growing by a single stem into a well-proportioned tree of moderate size; but its general habit is to fling up from the water margin a series of strong stems, outspreading, bush-like. Thus grouped and multiplied, it marks the course of the stream winding through the meadows; or bounds the waters of the mere, shade meeting shade in the reflection of quiet waters. For as there is no tree—not even its contrasting companion the Willow—that loves better the moist places, and the moist atmosphere over these, so no tree looks more at home, or fares better there. It seems to be equally content in the savage glens and ravines of the Highlands, and in our soft lowland meadows.

THE ALDER IN WINTER.

In *winter* its twigs are never wholly bare. Its multitude of little groups of cone-like fruits now gaping open, its even more numerous tightly closed, clustered cylinders—the flower catkins that are to be—give to the leafless tree a partly clothed appearance. And as these young catkins are already richly coloured, reddish brown to crimson, they impart a warm glow to the maze of twigs in the winter sunshine.

In *spring* the old cones are still there. The catkins of the pollen-bearing flowers elongate almost as early as those of the Hazel, and hang pendulous, covering the tree, as with living mantle of bronze, some weeks before there is the least sign of the later greenery.

In *summer* its deep green foliage, gathered into full masses, affords strongest contrast to the light filminess of that of

THE ALDER IN SUMMER.

ALDERS; "SHADE MEETING SHADE IN THE REFLECTION OF QUIET WATERS."

its companion Willows, suggestive of cool shade, somewhat dull and slumberous through days of gloom, but awakening and twinkling in sunshine.

In *autumn* the leaves merely darken still more, getting a touch of sombreness before their fall, which occurs later than with most, for the Alders are still green when other trees are glowing in orange and gold, and some are bare. Already are present, hidden away among the leaves, the young flower catkins in preparation for the following early spring-time.

The *stem*, if divided, raises its separate members direct from the soil of the river bank. The *bark* is dark in colour, furrowed and scaly. The winter *twigs* are brown, triangular in section, as are also the *resting buds*. These are placed spirally on prominent bosses, with supporting stays passing down the twig. They are all but enclosed in a single scale, and for further protection are coated with a light waxy "bloom." They are distinctly stalked, a unique peculiarity of the Alder among our trees; though there is some suggestion of stalks to the buds of the wayfaring tree. Here we get a reminder of the fact that these and all buds are, in reality, the first beginnings of branches, that they were more correctly thought of as cradled twigs than as cradled leaves. That the buds of the Alder are truly stalked may be seen from the position of the leaf-scar, at the base of the stalk. Buds which on many trees terminate dwarf shoots have the appearance of being stalked, notably on the Beech, but in these the scar will be found just under the bud on the top of the stalk, whilst the stalk below will show a series of crowded scars. There are no such

TRUNK AND BARK OF THE ALDER.

scars on the stalk of an Alder bud. The leaf-scars at the base of the bud-stalks of the Alder are heart-shaped (sometimes

YOUNG CATKINS AND OPEN CONES OF ALDER TWIG IN WINTER.

rhomboid), and show from three to five leaf-traces.

The *leaves* are rounded, tending to egg

ALDER LEAVES.

or heart shape, with broad, often deeply notched apex. They are of a deep shining green, and when young are somewhat sticky. The margin is cut into irregular teeth. The midrib passes direct to the apex, with five to seven pairs of side ribs to the margin.

The pollen-bearing and fruit-producing *flowers* are separate, but grow on the same

TWIG AND RESTING BUD (ENLARGED) OF ALDER.

tree. As already stated, they may be found, in their preliminary stages, in the preceding autumn, and are exposed all through the winter. Till February they are stiff cylinders, richly coloured, brown

to crimson. The pollen-bearing flower cylinders then expand, hang down loose and pendulous, a beautiful bronze, casting their pollen on the winds. The smaller stiff cylinders of the fruit-producing flowers grow in stalked groups of three to seven, and already have the appearance of tiny reddish cones. In process of transformation these enlarge on lengthening

THE HAZEL.

stalks, and become still more cone-like, woody and green, the size of beans.

The *fruit* is contained in this woody, cone-like receptacle, the hard scales of which gape open later to set it free. It is then carried by the wind, or floats upon the water, seeking right conditions for growth. But the hard gaping cones will be found on the tree for many months to come.

THE HAZEL

With us the Hazel is seldom allowed to grow into a tree. Found usually in our hedgerows, where it is frequently hacked and clipped, or as under-growth in the coppice, where it is systematically cut down to the stool, it has little chance of attaining size or proportion. Nor, indeed, does it evince any marked desire or aptitude in that direction, but rather the reverse. It prefers to maintain itself on a number of stems, and is continually throwing up fresh ones in the shape of strong stool and root suckers. So it must be regarded as a tree that, for reasons of its own, has chosen to adopt the habit of a bush, and best prospers so. We noted a similar tendency in the Alder, and shall find some other trees adopting more or less a like habit.

In *winter* should be noted the immature pollen-bearing catkins, stiff brown cylinders, slightly curved, in groups of two or more, growing mostly along the sides of the twigs. For the Hazel, like the Alder, makes preparation for the earliest possible flowering; but the Hazel is in the greater hurry. A day or two of warm

TREES

CATKINS—WIND POLLINATION

Specimens required :—Catkins of the Hazel

The Catkins with Stamens

Examine catkin of Hazel at the time of flowering. Note with a lens the structure of the catkin—*viz.* a collection of small flowers, each of which possesses stamens covered with pollen.

Pollen

Shake the catkins and note the shower of pollen dust. The same effect may be obtained by shaking a Hazel tree.

The Catkins with Pistils

Next examine carefully the flower of the Hazel and note crimson pistils. Note shape and contrast with catkins with stamens.

Wind Pollination

Observe a Hazel tree and note the large number of staminate catkins. These produce a large quantity of pollen, which is shaken out by the wind when the catkins open. Some of this falls on the pistillate catkin and fertilises it.

Examine catkins of Alder and Willow.

Hazel. catkins - wind pollination

THE TREE

atkin with stamens.

Catkin with pistils

Flower of catkin showing stamens (enlarged)

The fruit

zel twig.

The hazel bears two kinds of catkins - -one with stamens the other with pistils.
The first kind produce pollen, which is shaken out by the wind. Some of the pollen finds its way to the pistils of the pistil bearing catkins.
Thus the hazel is fertilized by the wind.

sunshine in January, and even in December, will often cause one or more of the stiff cylinders to lengthen out and hang down yellow with pollen as if eagerly anticipant of spring.

When *spring* really comes these yellow catkins are abundant. The Hazel then has all its pennons out in welcome, and they make a goodly show. Now must be looked for the little crimson flame-crests on many of the side buds, tiny but brilliant bits of colour, the only outward manifestation that the fruit-producing flowers choose to make. The leaves do not put in an appearance till considerably later.

In *summer* the broad leaves extend themselves in open layers on the spreading branches; and, if under partial shade as undergrowth in an oak wood, it is interesting to note with what purposed skill each layer of foliage secures the utmost of available light. Now should be watched the gradual uplifting from the twig of the young fruits, rising out of stalkless buds to stalked clusters with attendant leaves.

TWIG AND RESTING BUD (ENLARGED) OF HAZEL.

27

In *autumn* the foliage changes to yellow and rusty brown; the light green nuts in their frilled mantles assuming their characteristic nut-brown tint.

The *bark* on the stems is smooth. The *winter twigs* are brown and decidedly hairy. The *resting buds* are rounded, somewhat blunt, and flattened on the outer surface. They stand out from the twig on rather prominent bases, are greenish to brown in colour, and show several protecting scales. They are arranged al-

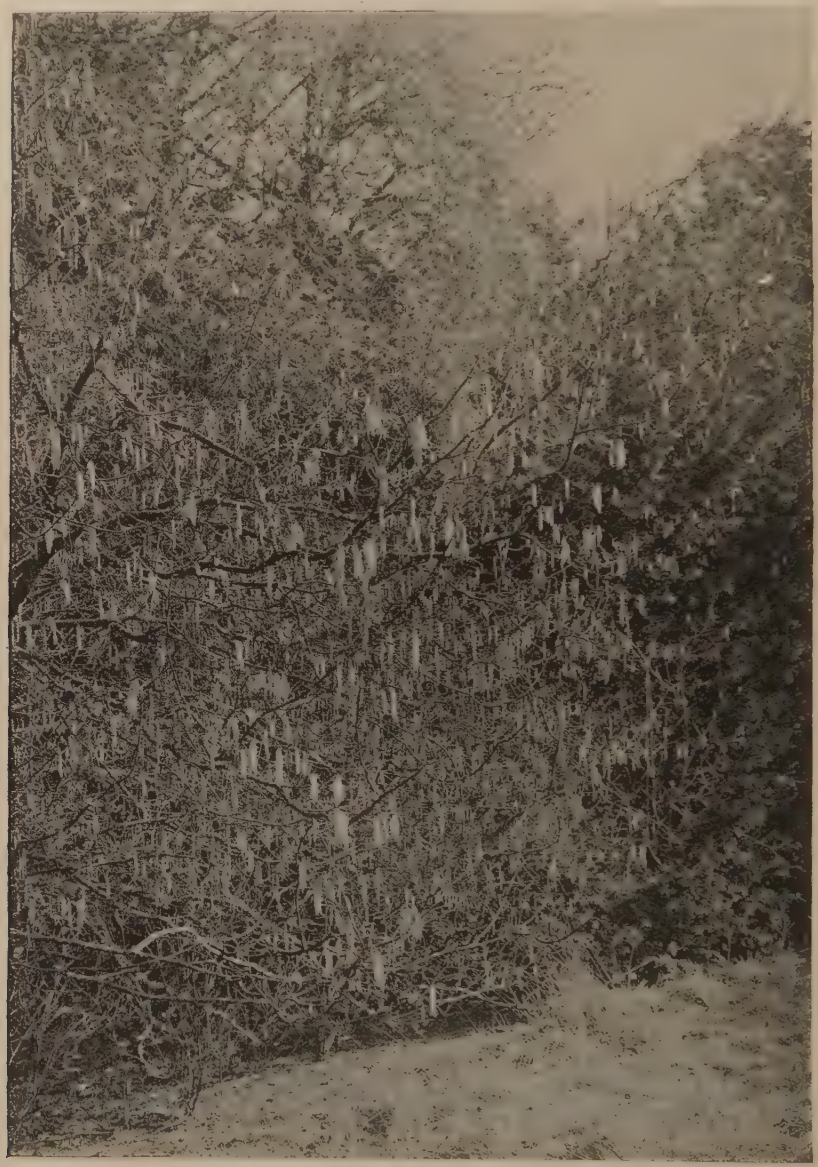
HAZEL LEAVES.

ternately on the twigs, but spirally on the erect suckers. The *leaf-scars* are almost semi-circular, with three leaf-traces.

The *leaves* are softly downy when young, but later become somewhat coarse and hairless. They are rounded, or broadly oval, with a suddenly elongated point at the apex; those on the suckers may show three such points. The margins are broken up into large teeth edged with smaller ones. There is one midrib with pairs of side ribs branching out from it. The short leaf-stalks are covered with glandular hairs that secrete a sticky substance perceptible to the touch. The *flowers*, pollen-bearing and fruit-producing, are separate, but to be found on the same tree. The pollen-bearing flowers, as stated above, are exposed through the winter as stiff, and short, brownish cylinders, growing, as spring approaches, into long pendulous yellow catkins in clusters. The fruit-producing flowers are enclosed in buds, slightly more rounded than the leaf buds, till in the spring they thrust forth their tiny crimson plumes. So they wait, receptive, for the wind-scattered pollen. Some weeks later the leaves unfold; then each flower bud starts into growth, producing eventually a stalk, with leaves, and clustered fruit.

The *fruit* is, of course, the typical nut with its scalloped husk, hard brown shell, and nutritious kernel. These nuts are so assiduously collected and planted by the squirrels, though for quite other purposes, that these lively little creatures may be said to be the main instruments in the dispersal of the seeds.

There is a Hazel gall-mite, similar to that which infests the Birch, which produces rounded swollen buds that never properly open. There is also a nut Weevil, a small brown beetle with a long snout, which inserts its egg into the young nut, and this develops into the fat maggot so often found in place of the sweet kernel.



THE HAZEL'S WELCOME TO THE SPRING.

HENRY IRVING.

HOW TO KNOW THE INSECTS

By JOHN J. WARD, F.E.S.

Author of "Some Nature Biographies," "Peeps into Nature's Ways," etc.

Illustrated from Original Photographs by the Author

PROTECTIVE MIMICRY

WITH the increasing host of insects, there is always a corresponding increase amongst their enemies. On this account, insects that appear late in the season run greater risks than those which make their advent earlier, for there are many young mouths to fill as the season advances. Insectivorous birds and other animals are ever on the alert for anything that moves amidst the grass, leaves, or branches, but the insects themselves show no such activity in eluding their foes. Many of the largest and most handsome species make not the least attempt to escape should the enemy approach. It is well, indeed, that they do not, for any active endeavour to escape would mean their sure destruction. Strange as it may seem, their chance of life often entirely depends upon their remaining quite still and thus presenting a negatively bold front to the enemy.

I propose, in this paper, to deal with a few of the numerous examples which illustrate how insects hide to protect themselves from their enemies. Those

TWO GREEN-VEINED WHITE BUTTERFLIES ON THE FAMILIAR GREEN AND WHITE STRIPED RIBBON GRASS.

who would learn to know the insects are just as likely to be "tricked" by the extraordinary guises they assume as a means of protection as are their natural foes. It follows, therefore, that this subject comes well within the scope of these papers.

The three common White Butterflies, with which everybody is more or less familiar, are known respectively as the Large White (*Pieris Brassicæ*), the Small White (*P. Rapæ*) and the Green-veined White (*P. Napi*). The first is readily distinguished by its size; the two latter are frequently confused, as they are both extremely abundant, and very similar in colour. The Green-veined White, however, may be distinguished by observing the under side of its hind-wings, which are conspicuously veined with green, from which feature the insect derives its popular name. It is well known that during sunlight these insects are always on the alert, and also that they are very capable insects when on the wing. It is obvious, therefore, that during sunlight they need little or no protection except their power of flight; but at night and on dull days, when they rest, these White Butterflies are conspicuous objects and necessarily have to hide away beneath leaves and in similar situations.

POPLAR HAWK-MOTH RESTING ON THE BARK OF A POPLAR TREE.

Now, during the summer of 1907, Green-veined White Butterflies were very abundant in my flower garden (this year I have seen but few), and I then discovered one method by which these insects secured protection during the nights and the whole of dull and wet days. Indeed, during the month of May, I could almost invariably find in the garden at such times a fair number of these butterflies. It so happened that some clumps of the familiar Ribbon or Lady's Grass had been allowed to grow large, and while pulling out some of this I found that I frequently disturbed a Green-veined White Butterfly. For a moment this surprised me, and then I suddenly realised the meaning of it. I immediately went to another clump of the grass at another part of the garden and disturbed it, and at once butterflies appeared. Another clump yielded a similar result; indeed, each of the whole six clumps provided from one to four butterflies.

Why were the butterflies amidst the grass? To answer that question I will ask my reader to glance at the first illustration. There are shown some blades of the familiar green and white striped grass. Observe, too, that amongst them there are two Green-veined White Butterflies. In the photograph on p. 211 the butterflies are conspicuous enough, because I have removed some of the blades from before the insects so as to show them in the picture. But let me now ask my reader to think of the conditions as they were in reality. The blades of grass striped and shaded irregularly with green and white, the butterflies hidden in amongst the crowded blades with their white wings pressed closely together, exposing only the under sides of the lower wings—the green-veined wings. The harmony was perfect; you might look *from above* a hundred times and yet never see a butterfly; to accomplish this you had to assist your eyes with your hands.

It was no coincidence. Evening after evening I could find butterflies amongst the grass. Even during the bright sunlight I frequently saw some of them alight amongst the grass blades to rest, just as if they knew that the situation offered them protection.

This instance of protective mimicry in connection with this common insect and a familiar garden plant has not, I think, been previously observed, and I offer it to the readers of "The Nature Book" as a novel instance which they may investigate on their own account. It should be remembered, though, that it must be the Green-veined White and not the Small White Butterfly that should be found amongst the ribbon grass. The latter, although it resembles the former, is a distinct species, and its hereditary instincts would be altogether different; for we have to recognise that the butterflies do not think out these protective schemes, but that they are the outcome of an instinct, inherited from habits of their ancestors, which have served a useful purpose in the development of the race.

It is probable that every insect possesses some similar hereditary protective devices. Some of these devices are, when observed, very obvious, as in the case of the caterpillars of the Swallow-tail Moth, with which I dealt in my first paper. In other cases the significance of the protective mimicry may completely evade us, though it be plainly before the eye. Some of the most handsome Hawk-Moths while resting openly exhibit mysterious arrangements of colour about their wings which, although conspicuous enough, yet seem to deceive the eye in such a manner that the insect escapes recognition as such. I referred to this feature when dealing with the Lime Hawk-Moth, and now we may glance at another curious instance in the case of another common Hawk-Moth. In the second illustration is shown the

PRIVET HAWK-MOTH RESTING WITH WINGS PARTIALLY EXPANDED.

Poplar Hawk-Moth (*Smerinthus populi*) resting on the bark of a poplar tree, as it might be found at any time towards

FEMALE BLACK ARCHES MOTH.

the end of May until early July, and occasionally in the autumn, from a second brood.

The moth has beautifully marbled wings of a soft buff-grey colour, and the lower wings are similarly coloured but of a bright orange shade of brown at the base. This coloured part, however, is covered while the moth is resting, as it appears in the photograph on page 212, and the peculiar manner in which the hind pair of wings appear first, give the moth a curious resemblance to a fallen leaf which is discoloured and shrivelled and adhering to the bark. Of course, it only needs a glance to see that it is not a leaf, but the whole arrangement is unobtrusive to the eye, and the untrained observer, even while searching for insects, would probably, if his gaze fell on such a moth, be deceived, and would turn away towards what seems like more profitable searching-ground. Therein probably lies the moth's main protection. If it attempted to hide in the fork of a branch or amongst the leaves, a large moth of that description would soon be discovered by the diligent insectivorous searchers that are persistently at work amongst the branches; but this bold front, combined with the subtle colour and superficial resemblance to a wind-blown leaf adhering to the bark, completely deceives the enemy. If a hungry bird espies it, it does not stop to investigate. Food requires searching for, and it would be too absurd to suppose that it would be exposed in that prominent way; so, like the untrained observer, the bird seeks more profitable fields. Almost invariably these moths will be found resting in such exposed situations. Not infrequently they will be seen on posts and palings, sometimes on flat wooden fences; which again illustrates the fact that the moth is only carrying out its hereditary instinct, for on a flat fence it is a most conspicuous object.

What I have written regarding the Poplar Hawk-Moth also applies to the insect illustrated in the next illustration (p. 213), where the Privet Hawk-Moth (*Sphinx ligustri*) is shown. In the photograph the moth is seen while taking a temporary rest, with its wings slightly expanded, and in that position it reveals the rosy pink bands that partly encircle its body. When it completely closes its wings, however, its body is covered, the upper pair, which

BUFF-TIP MOTH WITH WINGS FULLY EXTENDED.

are brown and black-streaked, being outside, and so it rests on the bark of trees, posts, etc. About the middle of July the moth may frequently be found in such situations. It follows, therefore,

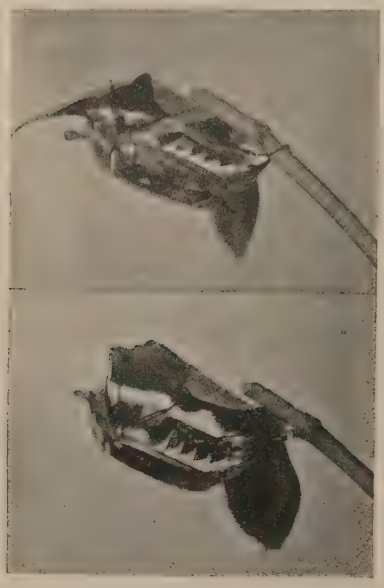
that those who search for insects should carefully observe tree-trunks, for not only will they often provide specimens of these most handsome Hawk-Moths, but also many other striking specimens that seek protection during daylight by similar methods.

While so searching amongst oak trees a very conspicuous black and white moth may sometimes be found towards the end of July and during early August. This moth is the Black Arches Moth (*Psilura monacha*) whose caterpillar I illustrated in my last paper. In the illustration on page 214 the female moth is shown. This moth certainly looks conspicuous on the dark-coloured bark of the oak tree where it is not infrequently found, for the caterpillar often constructs its cocoon amongst the crevices of the bark, and necessarily when the moth emerges it first appears upon the bark and there unfolds its wings, often so resting for several hours after its emergence. The male moth may be readily recognised by its smaller size and feathery antennæ. Although the moth appears to us so conspicuous on the bark, yet probably to its natural enemies it is much less so: for such irregular splashes of black and white colour are frequently seen about the bark where birds have been moving. On the other hand, it may be quite conspicuous to insectivorous foes, and its black and white wings may be its "warning colours" indicating to them that it is inedible and unwholesome for food, as I suggested in the case of the variegated livery of the caterpillar.

A PAIR OF BUFF-TIP MOTHS RESTING: SHOWING THEIR RESEMBLANCE TO PIECES OF BROKEN STICK.

A paper on this subject would scarcely be complete without a reference to the Buff-tip Moth (*Phalera bucephala*), which is abundant during June and July. This insect is shown with expanded wings in the lower photograph on page 214. Its upper

pair of wings are of a silvery-grey colour, with an oval buff patch at the tip. When the moth comes to rest it wraps its fore-



COCKCHAFER BEETLE FEEDING.
The lower photograph was taken three minutes after the upper, and shows the progress made by the Beetle in his meal.

wings round its body in a peculiar manner, which gives it the appearance of a bit of broken stick, its buff-coloured head, and the patch of the same colour on the tip of each fore-wing, resembling the broken ends of the stick. The illustration on page 215 will explain the matter better than a volume of words. There a pair of the moths are shown just as I found them resting. These interesting moths are very common, and may be found about the bark of various trees, especially elms, and not infrequently amidst the grass and herbage.

Another insect that resembles a bit of broken wood or peeled-off and shrivelled bark is the familiar Cockchafer Beetle (*Melolontha vulgaris*). At night time it takes to its wings and is a bold but somewhat reckless flyer. One night, while cycling, my bell suddenly rang out one note quite loudly. No one was near, and I had not touched it. A little startling, it is true; but I knew that the invisible musician was no other than the clumsy Cockchafer; a second later I heard his horny body fall amongst the herbage in the ditch. What he thought of the noise, to say nothing of the shock, will always remain unknown. During the day these insects sleep amongst the leaves, but occasionally they wake up and munch a piece of the leaf, as shown in the illustration on this page.

I now only have space to add the illustration, referred to in my last paper, of the Brimstone Butterfly. The photograph shows the newly emerged butterfly clinging to its empty chrysalis skin, while its wings dry and come under muscular control. The butterfly that emerges in July or August lives throughout the winter, but where it hides during that period is a complete mystery. Holly bushes have been suggested as a likely place, and it has been pointed out that its quaint-cut wings resemble a yellow, dried holly leaf. The suggestion is ingenious, but I have never yet discovered a Brimstone Butterfly in that situation, although I have searched many times; neither have I heard of any one who has so discovered

A BRIMSTONE BUTTERFLY JUST EMERGED FROM ITS CHRYSALIS, TO WHICH IT IS CLINGING WHILE ITS WINGS DRY.

it. Nevertheless, on the first sunny day that presages spring, the butterflies appear—from somewhere!

JOHN J. WARD.

A CORNISH SEA AT HALF TIDE.
From the painting by Arthur J. Black.

WAVES BREAKING ON A REEF.

WAVES AND THEIR WORK

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

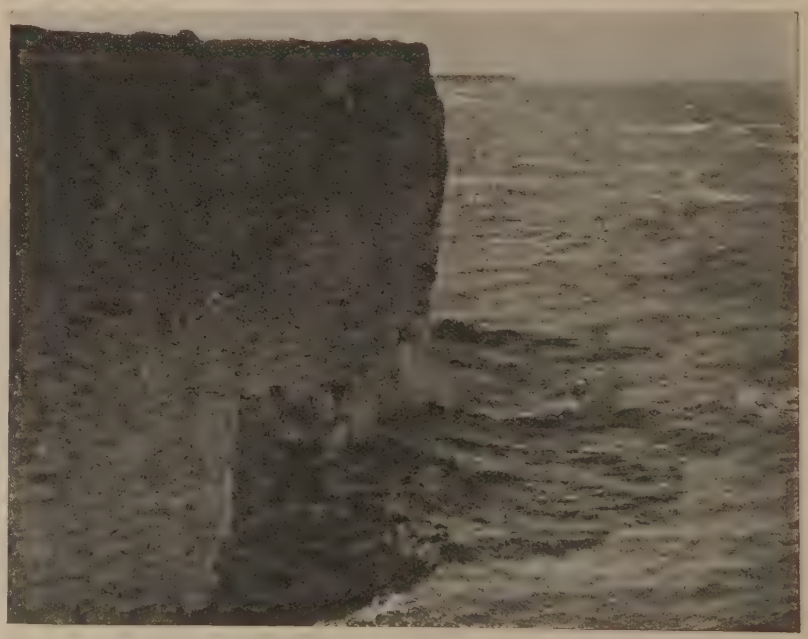
A WINTER storm on a rock-bound coast is an awe-inspiring sight, which once seen is not easily forgotten. What a change from the brilliant sunlight and gently flowing tide of the summer, to the hurrying grey storm-clouds, the boom and crash of the waves thundering against the cliffs, and the wild screech of the beach as the pebbles are drawn down by the backwash! Then it is that we begin to realise the devastating power of the waves, and the work they accomplish.

The waves are constantly at work along the whole eastern coast of England, eating away the land, so that from Flamborough Head to Kilnsea, where the strata are composed of drift or boulder-clay—comparatively unresisting materials—from two to four yards of land disappear annually; and in the same way all the soft coast cliffs from the Humber to the mouth of the Thames are being washed away by the waves. Historic Ravenspur, where Bolingbroke landed in 1399, has long since disappeared beneath the surface of the sea, and the old town sites of Dunchurch and Cromer lie beneath the waves of the North Sea. Amongst the fisherfolk of Norfolk an ancient superstition still lingers, that on dark and silent nights before a tempest, the old bells of the long since buried church of ancient Cromer may be heard faintly ringing a warning peal.

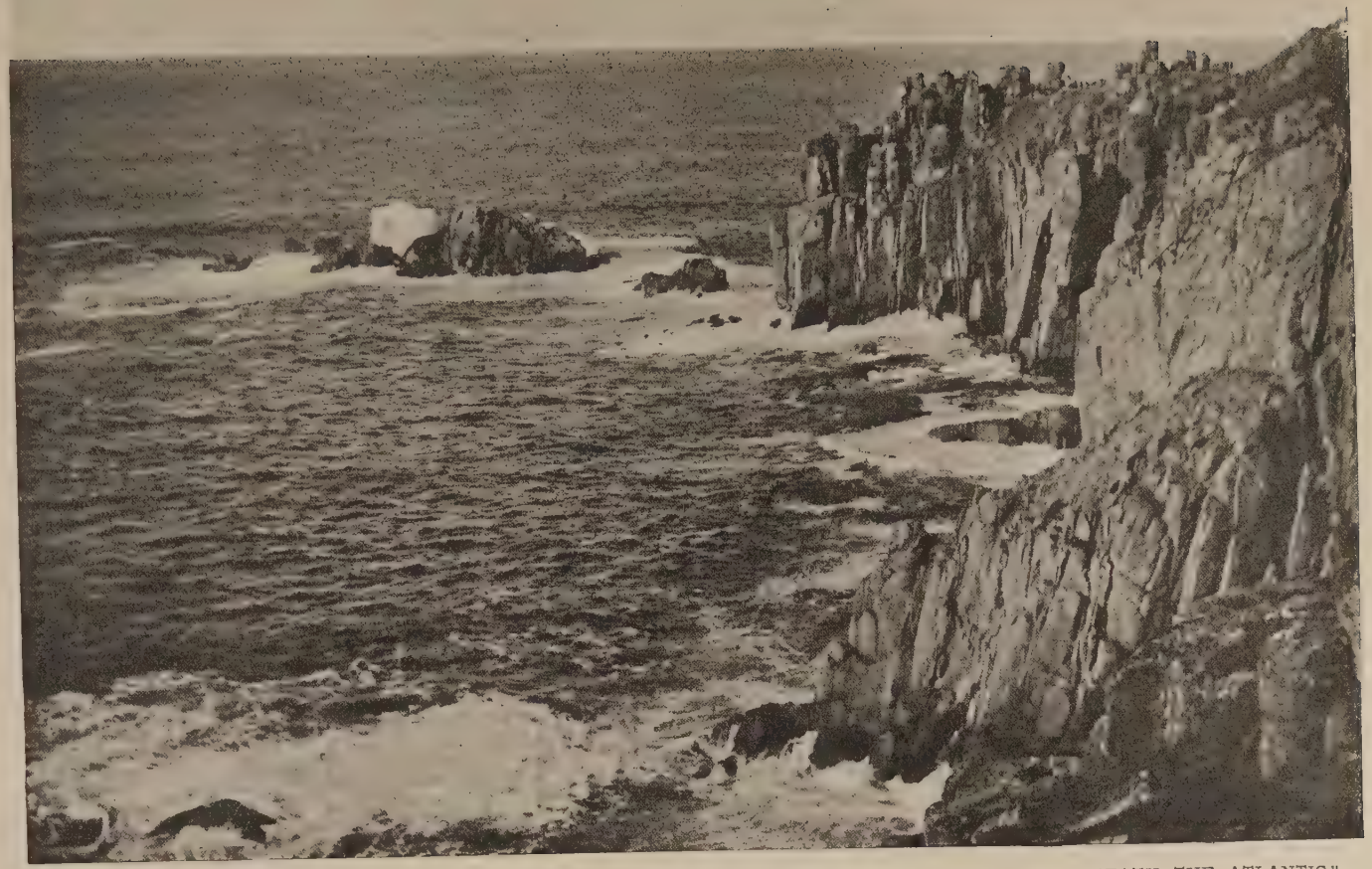
The coasts of Kent and Sussex are also in many parts being rapidly worn away. The twin towers of the ancient church of Reculvers would have disappeared beneath the waves long ago but for the stout sea-wall and groins which have been built to protect them; while the site of old Chichester has quite disappeared, swallowed up by the all-devouring waves.

A ROCK TOWER ISOLATED BY THE WAVES: "OLD HARRY," SWANAGE.

The sea takes advantage of every weak point in the strata of the cliffs, so that every seam of soft earth or rock formation is attacked and eaten away by the waves, leaving the harder and more resisting rocks standing; and it is in this way that the bays, capes, and promontories have been formed. Looking at a geological map of Great Britain, we can trace the hard "basset," the upturned edge of the chalk formation, running diagonally from Dorset to Yorkshire; on the southern shore forming the promontory and cliffs of St. Alban's Head, and on the Yorkshire coast the magnificent headland and cliffs of Flamborough. Following its inlying edge that surrounds the Weald, we trace the "basset" to the shore at Dover where the gigantic mass of Shakespeare's Cliff towers aloft, and again where it touches the Channel, we see Beachy Head rising majestically from the waves. But for the durability of this harder chalk formation, the Isle of Wight would prob-



WAVES UNDERMINING A CLIFF.



"BUT FOR ITS IRON-BOUND COAST . . . . CORNWALL MUST LONG SINCE HAVE DISAPPEARED BENEATH THE ATLANTIC."

ably have long since disappeared. It forms, however, the rocky backbone of the island, and every visitor to that delightful spot knows the beautiful towering chalk cliffs of Freshwater, that beat back the hungry waves, and the Needles rocks, that once formed part of the island.

If we travel down to the Land's End during the winter months and witness some of the terrible storms that sweep

A GATHERING STORM ON THE DORSET COAST.

along its cliffs, we soon realise that but for its iron-bound coast of hard granite and metamorphic rocks, against which the angry waves hurl themselves in vain, Cornwall must long since have disappeared beneath the Atlantic.

Where the set of the current is strong, the *débris* torn from the cliffs and pounded by the waves into fine sand and shingle is carried away, the finer particles out to sea, where they accumulate and form treacherous, shifting sandbanks, like the Goodwins; while the coarser pebbles form the ever-moving pebble beaches, of which the Chesil Bank near Portland is a familiar and remarkable example. The waves are hard at work striving to sweep away Portland, which forms a natural groin protecting the Dorset coast, and once the work of destruction is completed, the coast of Dorset will have to face the full fury of the storm-lashed waves.

Although the work of wearing away the cliffs is constantly going on, there is a certain amount of give-and-take, for in situations along the coast where the currents do not run so fast, or where they set more towards the shore, sand and *débris* is constantly accumulating, so that fresh land is forming. This is seen on flat, sandy shores that are bounded landwards by the low sand-hills or "dunes." These "dunes" are formed when the tide is out and the wind is blowing off the sea. The wind then lifts the sand as it dries, and carries it landwards until it reaches the low scrub of reeds and grasses which grows just beyond the reach of the waves. Here the advance of the sand is arrested, and it falls amongst the stems of the reeds and grasses.

Gradually the sand accumulates and covers the binding mass of vegetation, until a long, low ridge of dunes is formed.

In situations where the waves break upon the shore obliquely, we may watch them at their work grinding down into pebbles the hard fragments of rocks which they have torn from the cliffs. Every incoming wave drives forward obliquely the shingle composed of more or less smooth, rounded rocks of all sorts of sizes; and these, as the wave retreats, seem to give chase, rolling down perpendicularly to the shore line, after it. Rows of wooden piles, or groins, are fre-

quently driven into the beach to arrest the eroding action of the waves, but although this stops the advance of the pebbles for a time, the waves before long pile up the pebbles to the height of the groin, and then start to work to form a new beach a little further from the land. The oblique action of the waves, and how they therefore pile the pebbles always against one side of a groin, is very strikingly illustrated at Brighton on the Sussex coast, between the Palace Pier and Black Rock; where, looking seawards, the pebbles are piled up nearly flush with the top of the right-hand side of each groin, there being quite a drop of three or more feet to the beach from the top of the groin on the left-hand side.

THE BACKWASH OF THE WAVES CARRYING AWAY THE SOFTER SAND AND DÉBRIS FROM THE CLIFFS.

Another wonderful and most interesting piece of work done by the waves is the formation of what are called coast platforms, or sea-terraces. Wherever the coast is being eroded with more than ordinary rapidity, these wave-worn terraces may be seen in course of formation; indeed, in favourable situations several of these platforms are visible at the lowest spring tides, rising as a series of broad shelves or terraces cut out by

TERRACE FORMATIONS AT BARTON CLIFFS.
The three lower terraces are due to the action of the waves at highest and lowest tides, the upper ones to subsidence of the land.

the waves; that nearest the water's edge the waves have formed during the lowest neap tides, the next during the intermediate tides, and the highest reaching to the base of the cliffs during the spring tides. These terraces are formed by the waves in the first place beating against and eating into the cliffs and undermining them; then the unsupported overhanging portions break away and fall into the sea, only to be pounded into fragments and carried off by the currents into deeper water; and in this way the seaward edge of the land is ground and worn down to a more or less uniform level. In many parts of England and Scotland, traces of ancient sea-terraces are to be seen inland and high above the present level of the sea, showing that during geological ages the land has gradually risen and preserved the record of the waves and their work in the past.

F. Martin Duncan.

THE WRECKAGE OF THE WAVES.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE PLANE

ABUNDANT as the Plane tree now is with us, it is of comparatively recent introduction. It has never lost its foreign, almost Oriental, air. We can scarcely be too grateful for the bounteous brightening greenery it uplifts in the ways and squares of our cities, where it holds its own in spite of vitiated air and clogging impurities. It lives, and fairly thrives, and little abates its sunshiny suggestiveness, its Orient fulness, splashing here and there golden gleams over drab streets; in stifling August heat casting cooler shade that by contrast is refreshing. Yet the tree is un-English, with its speckled trunk and limbs, its broad geometrical leaves, its curious dangling flowers and fruits, its billowy massed crown. It is with us pre-eminently the city tree — city and suburban—and by it city and suburb are so far redeemed; but it seems rather out of place in our country-side, and strikes an alien note in our English landscape.

In *winter* the appearance of the tree is distinct and characteristic. Its central stem rises often to the summit, but from it are thrust out large elbowed branches of varied lengths, which follow no very defined plan, so that the tree's form is decidedly lacking in symmetry. The

THE PLANE IN WINTER TIME.

speckled appearance of the trunk and limbs is then most noticeable, as it is at this season that the bark flakes off, leaving light yellow patches on the darker ground, a kind of reversed leopard's spotting. All through the winter its globular clusters of fruit, grouped on

TRUNK AND SCALING BARK OF THE PLANE.

pliant stalks, dangle in crowds among the twigs.

In *spring* the buds are rather late in opening, but when the foliage does appear it is soon full and golden. At the same time the globular groups of flowers on slender hanging stalks, similar in appearance and habit to the still dangling fruits of the previous season, grow out from among the expanding leaves.

In *summer* the rounded masses of broad-spreading, semi-opaque leaves suggest and afford ample and welcome shade. The ripened fruits of the former season have now mostly vanished, and the pollen-bearing flowers also, but the new fruit-globes on their slender stalks are growing apace, so the succession of these may be maintained through autumn and winter to the new growths of another spring-time.

In *autumn* the leaves change to yellow

THE PLANE LEAF.

and orange, or reddish brown. They fall late, exposing fully the dangling fruit clusters.

The *trunk* is round, smooth, and well

THE LEAF AND THE BUD OF THE PLANE.
Showing how the base of the leaf-stalk forms a protective sheath for the bud.

sustained. In age it often becomes roughened and heavily warted at the base. The

WINTER TWIG AND BUD (ENLARGED) OF THE PLANE.

bark is thin and unwrinkled, naturally somewhat greyish, but darkened, if not blackened, by the city's smoke. Here it is that the distinguishing habit of the Plane is so marked and beneficial. The thin bark scales off in patches, exposing the new yellow under-bark, so ridding the tree of the accumulated impurities of city life.

The *winter twig* is rounded, slightly zigzag, and olive green in colour. The *buds* are arranged alternately on the twig; they project, are conical in shape, and are protected by a single brown scale which forms a complete sheath. These buds through all the period of their growth are hidden in the bases of the leaf-stalks, and are exposed to view only by the fall of the leaves. In consequence the *scar* left by the fallen leaf is circular, all but surrounding the base of the bud. It has a sinuous outline, and shows five groups of leaf-traces.

The *leaves* vary considerably, even upon the same tree. They are large, widespreading, and markedly geometrical. They have deeply cut margins forming generally five main divisions, each again cut into by smaller indentations. Instead of a single midrib, as with every tree previously considered, the Plane leaf has three main ribs, radiating from the point where the stalk enters the leaf, and terminating in the apices of the three central main divisions. The two remaining main divisions of the leaf are supported by strong ribs branching outwards from near the base of the two outermost main ribs. So the leaf is only approximately of the five-fingered type. Golden when they first appear, these leaves soon acquire their permanent tint of vivid green. Their firm, smooth texture ensures that every passing shower shall wash away impurities, so they are able to breathe and thrive, and continue clean and bright, in positions where most other leafage is soot-soiled and choked.

The *flowers*, pollen-bearing and fruit-producing, are found on the same tree. These appear with the leaves, growing from the tips of new dwarf shoots, both kinds as globular clusters attached to

FRUIT AND FLOWERS OF THE PLANE.

long slender stalks. The pollen-bearing clusters are greenish, changing to yellow as the pollen matures. The fruit-pro-

ducing clusters are readily distinguished by their numerous purple-tipped spines, to which the wind carries the needed pollen.

The *fruits* grow into hard, roughened balls, composed of a multitude of wedge-shaped little nuts. From the thick rounded head of each little nut projects a short, stiff spine, curved at the point. From one to four of these balls, or "buttons," as Americans name them, grow attached to a single, long, flexible stalk. As already stated, these remain on the tree till spring is well advanced. Then the small nuts begin to separate. Each, as it emerges from the cluster, displays a circle of golden hairs arranged and expanded parachute-wise on the inner tip of the wedge-shaped nut. The expansion of these hairs thrusts the nut out from the cluster, and the parachute arrangement sends them sailing down the wind and ensures a wider scattering. The stalks, too, that sustain these fruiting balls from autumn to spring, gradually disintegrate, weather-worn, and become merely ragged fibres that barely support the weight of the ripened nut clusters; so that where these have not already been separately dispersed, they fall in mass about the time that the leaves and flowers have reached maturity.

Two main varieties of Planes are distinguished—the Eastern and the Western. The Western Plane is the "Buttonwood" tree of the Americans. The differences between these varieties are but slight. Most of our Planes are of the Eastern variety; the Western is seldom met with in Britain. Perhaps the commonest of all with us is that specified as "maple-leaved," and very generally as "the London Plane." It approximates to the Western type, though it is usually regarded as a hybrid between the Eastern and the Western. Its chief tendency is to have fewer and less decided leaf divisions than the Eastern Plane, and one, or at the most two, spherical fruit clusters attached to a single stalk.

In distinguishing the Planes from the Sycamore and other Maples, it is enough to note the speckled bark and the alternate bud (and consequently leaf) arrangement of the Plane; also, particularly, the hiding of the bud in the base of the leaf-stalk, or, when the leaf has fallen and the bud is exposed to view, the circular leaf-scar that surrounds it. The Plane's globular clusters of flowers and fruits on hanging stalks also are conclusive as to its identity.

HENRY IRVING.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," etc.

THE HEDGEHOG

With Photographs by the Author

IN the three following articles I propose to deal with our five insectivorous animals—the Hedgehog, the Mole, and the three species of Shrew Mice.

The order to which these animals belong is an extremely interesting one, not only on account of its antiquity (something very like our Hedgehog has been in continuous existence since the Pleistocene period), but also on account of some peculiarities of structure, habit, and character, which are excellently displayed by its British representatives.

However correct the attribute "insectivorous" may have been in Pleistocene times (and it seems not unlikely that the first small animals on our planet perforce were insectarians), it is characteristic of the modern representatives of the order, found in this country, that their taste in

AN OLD HEDGEHOG.

food is catholic, the only distinct preference they display being for something "crunchable."

There can be little doubt, however, that the tendency to hibernation, which is undoubtedly marked in the Hedgehog and Shrew Mice, and which is probable in the Mole, points to an early stage at which hibernation was a provision of Nature to prevent these small beasties dying of starvation in the winter.

There are certain outward features which are characteristic of all five of our British Insectivora. They are all small animals (it may be mentioned that the largest insectivorous animal known, the Tenrec, is less than two feet long, but atones for this comparative insignificance by usually producing about twenty young at a birth); they are all, under normal conditions, silent animals; they all have long pig-like snouts, and they all have five toes (the primitive number) on each of their four feet. They are plantigrade, and their bodies are slung low between their legs, which results, in the Shrew Mice, in a squirming method of progression, and, in the Hedgehog, in an ungainly waddle, during which his body zigzags head to tail, and he seems at every other step to leave one leg behind him. Neither Hedgehogs nor Moles seem able to sit back on their haunches, but Shrew Mice not infrequently rely on their hind feet alone, and can sit, and even run a few steps, with their fore-feet unsupported.

The outward appearance of the Hedgehog is probably familiar to most people. His back and sides are thickly studded with dark-banded, sharp-pointed, highly elastic quills. These number about 270 to the square inch, and the sum-total of them, taking an average specimen and regarding him as a sphere, works out at about 16,000. Each quill is spindle-shaped with a decided bend at the insertion of the root, and consists of a pith, an inner, and an outer shell. The outer shell is furrowed throughout its length, while a cross section shows that the inner shell (a thickening of which gives hardness to the tip) projects into the body of the quill in a series of ridges which correspond to the furrows without. The pith is traversed by a delicate net-

HEDGEHOG CLIMBING.

work of tissues, which are attached to the projecting inner ridges and to the spaces between them.

The object of this beautiful structure (as a whole) is evidently a nice adjustment between the rigidity necessary if the quills are to act as a defensive weapon, and the elasticity necessary to prevent their breaking short off, or being driven backward through the skin, as a result of a fall or violent blow. I have never known a Hedgehog follow the books so far as to take a fall voluntarily, but a Hedgehog, higher than he cares to be, will waddle backwards and forwards along the edge of the drop, until his own clumsiness eventually sends him over. As he loses balance he instinctively rolls up, and, if the fall is from a fair height, he has time to make a ball of himself. If the fall is a short one he lands anyhow.

THE HEDGEHOG, UNCOILED AND COILED.

An additional protection against the quill acting as a two-edged weapon is afforded by the form of its root. This is mushroom-shaped, the flat surface being towards the skin and the round surface towards the body. The flat surface effectually prevents the quill from being pulled out (a Hedgehog can easily be lifted by a single quill), while the round surface helps to prevent laceration of the tissues below if a sudden blow drives it in. The taper at the root end tends to make the quill more elastic.

The quills are brought to the charge mainly by a sheet of striped surface muscle, the *panniculus carnosus*, which extends over the whole of the animal's body and makes him, quite apart from his prickles, a very difficult subject to skin.

Fragmentary patches of this muscle appear under different names in ourselves, and boys are occasionally to be met

with who have sufficient control of such patches to wriggle their ears and move their scalps. I fancy that these muscles atrophy from disuse, as the power appears to lessen with advancing years.

something like the carapace of a tortoise, with a decided thickening round its lower edges. Beneath this skin-covering, which, under such conditions, would seem to be hardly attached to the body at all,

1. Magnified section of pointed end of quill, showing at the top the pith, the inner, and outer shells; and generally the net-work of tissue in the interior.
2 and 2a. Magnified sections (superficial) of quill, showing the mushroom shape of the root end, and, in 2a, a portion of the erecting muscle attached to it.
3. Magnified superficial view, showing the exterior ribbing.
4. Cross sections, showing the projections of the inner shell into the pith.

THE HEDGEHOG'S QUILLS.

Though the action by which the Hedgehog converts himself into a ball of spikes can be accomplished in a moment, the muscles which determine it are highly complicated—indeed, there can be few muscles in his body which are not brought into use when he rolls up. If a Hedgehog were to be, in imagination, divested of his quills while in an ordinary standing position, there would appear on the upper portion of his body and on his sides a wrinkled grey skin-covering, in shape lies the sheet of *panniculus carnosus*, and there are connected to it, in addition, a number of powerful muscles, which are linked up to the head, tail, and limbs.

On suspicion of danger, the first thing a Hedgehog does is to wrinkle up his forehead so that his quills project outwards and partially conceal his eyes. Perhaps his most engaging expression occurs under these conditions, for, as can be seen from the illustrations, his eyes acquire an undue prominence when his hair and quills

are neatly brushed back. He next rounds his back and tucks his face, four feet, and tail, together into his stomach. At this stage, viewed from the side, he is shaped like a nautilus, while the last glimpse of his black nose and paws, with their surround of hair, reminds one curiously of a befrilled infant. Finally he tightens up until he is practically spherical, with nothing but quills visible, and every quill pointing outwards.

He now presents a defence which few animals care to engage, though it is said that the fox and badger can pull him to pieces (the badger certainly could), and I have known a case of a retriever who habitually ate Hedgehogs, spines and all, and who eventually died of gastric trouble induced by the consumption of a particularly large specimen. The injury was probably mechanical, as it is not likely that ordinary Hedgehogs' quills would defy a dog's digestion. They can be considerably softened by boiling water, while a few hours' soaking in turpentine will reduce them to a pulpy condition. Each quill, in fact, is a single modified hair, so that, as a general rule, we can find four different kinds of hair in the Hedgehog—the quill, the bristle, the coarse hair, and the fine hair, whose diameters at their thickest portion average 1·2, ·11, ·06, and ·02 millimetres respectively. The bristles and the coarse hairs are remarkable for the small size of their pith in comparison with their shell, while in the fine hairs the pith can hardly be traced at all. A tame Hedgehog enjoys being stroked, and will lay his quills back for that purpose.

HIGHLY MAGNIFIED CROSS SECTION OF THE HEDGEHOG'S QUILL.

I do not think that the Hedgehog deliberately uses his quills for any purpose other than defence. The quaint appearance which he sometimes presents in the spring, owing to the quantity of nest material sticking to him, is due simply to the movements which he has made in settling down in his nest for the winter, and in waking up from his long sleep. The idea that he can climb trees and spike the apples need only be mentioned to be dismissed.

Yet, considering his natural disadvantages of build, he is no mean climber, and I have known one escape from a first-floor room by climbing from the floor to a chair, from the chair to a table, from the table to a window-sill, and thence to the branch of a tree which came close up to the wall. He negotiated part of this branch successfully, then lost his balance and fell, but waddled off triumphant.

The phenomenon of hibernation which I touched on in the case of the Dormouse is displayed even more markedly in the Hedgehog. His torpor lasts from November to March, and is, I think, normally unbroken. I have had the opportunity of making daily observations on the hibernation of three individuals, and I am certain that in these cases the animals remained torpid from the time they turned in until the time they turned out. There are, however, many instances recorded of Hedgehogs roaming at large during hard weather, and I have more than once myself encountered them in snow.

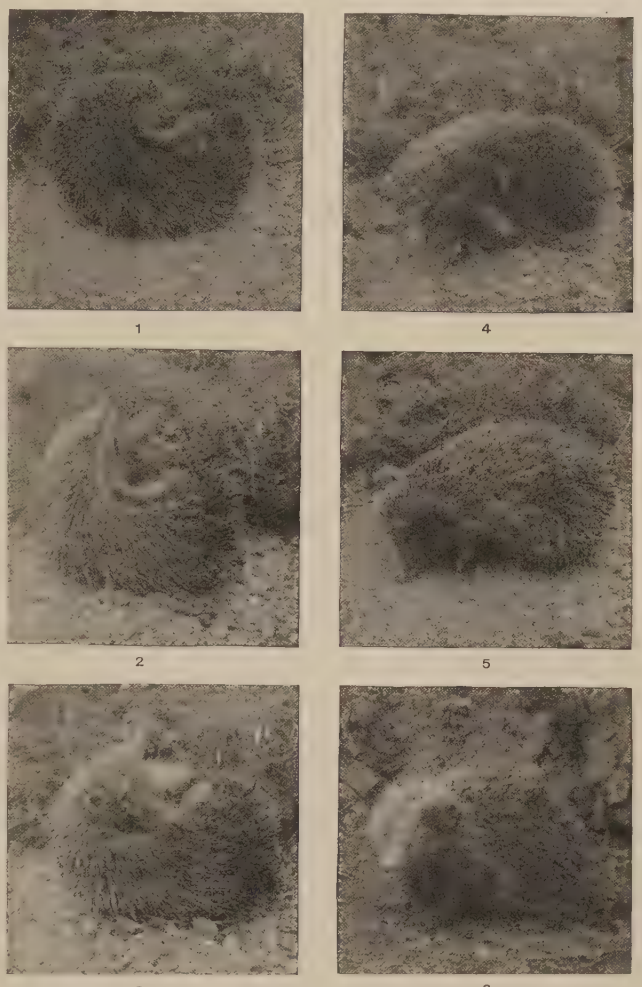
The Hedgehog possesses "hibernating" glands. The nature and function of these are uncertain, but it seems generally agreed that they attain their greatest development in the autumn, and atrophy in the summer. We shall have something similar to consider in the case of the Shrew Mice. So far as the Hedgehog is concerned, the matter has been ably dealt with by Dr. Carlier.* Among the interesting facts he brings to light, is the absence of sweat glands and sebaceous glands (the former, of course, implying an opening to the air) on the quill surface of the Hedgehog's body, and the migration of armies of phagocytes at the commencement of hibernation towards those portions of the animal's body, mostly situated in the alimentary canal, which are, at this critical period, dangerously exposed to assaults of bacteria.

If we consider the normal position of the hibernating Hedgehog—a tightened

* "Contributions to the Histology of the Hedgehog." Edinburgh, 1892.

ball with the conjunction of head and tail towards the ground—the interest of these facts is materially heightened.

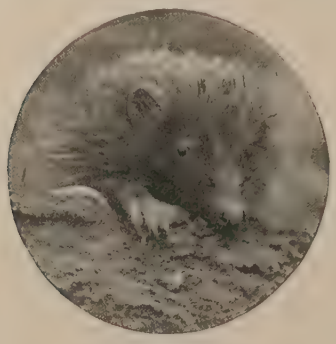
Remembering the character of the Hedgehog's natural food, which consists of worms, grubs, snails, beetles, lizards, meadow mice, and generally such small creatures as he can catch by snouting at sundown; remembering also that his hibernation is, as a rule, unbroken, it is not surprising to find that he makes no provision against the winter. Unfortunately for himself the Hedgehog is unable to discriminate between what is (humanly) lawful food and what is unlawful. Where an animal is suspected of damaging either the eggs or young of game, it is difficult to get a fair hearing for evidence in his favour, but the conclusion that, because a Hedgehog may be caught in a gin baited with a broken pheasant's egg and set in his usual run, a Hedgehog must of necessity be a stealer of pheasants' eggs, is, on the face of it, absurd, and the capture of a hundred Hedgehogs devouring pheasants' eggs would hardly justify the game-keeper's gibbet. I have seen a song-thrush peck a litter of harvest mice to pieces in hay-time, but I should not feel justified on that account (though harvest mice are dear to me) in shooting every thrush, and every bird I thought looked like a thrush, at sight. I should try rather to consider whether anything could be put to the credit side. Were a game-preserver to ask me to give an unbiased opinion as to whether Hedgehogs were destructive to game, I would answer that they were. That they would eat the eggs if they could crack them; the young, if they could catch them; and even the hen bird, if they could get a grip of her. I would say the same of badgers, foxes, stoats, weasels, otters, polecats, squirrels and rats. I would say the same of many birds, but I should try to present the case fairly, and, if I were successful, I should convince my questioner that the day when the last of the "vermin" was destroyed would be a bad day for "land."



THE SUCCESSIVE STAGES OF THE UNCOILING OF A HEDGEHOG FROM THE "NAUTILUS" POSITION.

The possibility of Hedgehogs preying on snakes is of some interest, and a few years back I had the curiosity to investigate the mutual relations between Hedgehogs and Vipers. More recently I have experimented with Hedgehogs and Grass-

snakes, but in neither case have I been able to come to any definite conclusion. In my first experiments I was only



A YOUNG HEDGEHOG.

once certain that the approach of the Hedgehog was unnoticed by the Viper. On this occasion Hedgehog sniffed at Viper (as he will sniff at anything he thinks may be eatable), and probably touched her with his nose. The effect, so far as Viper was concerned, was a quick cross-swing of the head and a vicious hiss. Hedgehog coiled instantly, and, by the time he had undone himself, Viper had withdrawn to a quieter place. On all other occasions I think that Viper sighted Hedgehog first. If she remained still, her eye and the tremor of her head were sufficient to keep Hedgehog at a respectful distance, but more often she retired in stately fashion as Hedgehog approached —anything for a quiet life. Hedgehog, even when fasting, would make no attempt to follow her up. In my more recent experiments with a Grass-snake (of which I give two illustrations), Hedgehog once succeeded in getting in a bite. In this case, too, Grass-snake was unaware of his approach, and the bite was evidently trivial, for she lunged straight at him. Hedgehog coiled up like a flash, and Grass-snake, trailing her whole length across his upturned quills, made for the nearest cover. There is little doubt, I think, that the Hedgehog, in order to eat a snake, must be able to come upon it unawares and break its back with a single bite. To be caught unawares the snake would almost certainly be coiled, and, for the Hedgehog to get in an effective bite, the coils would have to be favourably disposed; while the fling of a slightly wounded snake would certainly frighten the Hedgehog into a ball, and so give the snake a sufficient start to secure its safety. With quite young snakes, both viperine and others, the case is, of course, different. The stretch of the Hedgehog's jaws would accommodate any portion of their bodies, and I have no doubt that he is capable of pursuing, catching, and consuming them. It must be remembered, however, that Hedgehogs and snakes are seldom to be found abroad during the same hours of the day.

I have mentioned that the Hedgehog is a silent animal, and this is certainly the general rule, though I have at times been able to locate one by hearing a subdued snuffle in the grass—and the cry of a Hedgehog caught in a gin is said to

TWO YOUNG HEDGEHOGS IN A NEST.

be heartrending. This, I am glad to say, I have not heard. On one occasion, however, when I accidentally hurt a Hedgehog in an endeavour to keep him open, he uttered a sharp, spitting yap, and bit me rather severely. Under the

" Grass-snake was unaware of his approach."

"She lunged straight at him."

HEDGEHOG AND GRASS-SNAKE.

circumstances, the alternative method of defence may be forgiven him.

The Hedgehog probably has more than one litter in the year, each consisting of four or five young, which are born blind and, as one would naturally expect, without quills. The latter commence to appear within twenty-four hours. They are at first quite soft and scattered at fairly wide intervals. The spaces, however, fill up quickly, and in about a fortnight's time the little beast is fairly covered, as far as his back is concerned. The hairy portions of him take longer, and it is a full month before his quills stiffen and he can coil himself up like mother. Parents and young remain together for a considerable time, and I have more than once found a whole family hibernating together.

The two young Hedgehogs whose photograph is given on page 232, were the subject of rather an unfortunate experiment. The nest was discovered while some waste ground was being cleared, and as I was doubtful of being able to give the young ones the attention which young animals require, and yet was in need of Hedgehogs, I set a box-trap in such a way that the only entrance to the nest lay through it, and retired in the full confidence of being able to capture the mother. Some marauding beast, however, managed to scent the young ones during the evening, and on returning at midnight I found everything but the trap disturbed, and the young ones gone. I left the trap and caught what I presume to have been the mother on the night following, and what I presume to have been the father on the night after that.

DOUGLAS ENGLISH.

SOME COMMON BRITISH FUNGI

By MAUD U. CLARKE

Illustrated with Photographs by Henry Irving

BEFORE giving some description of the eight varieties of Fungi which are illustrated in this article, it would be well to consider, briefly, the main characteristics of the family in general.

The Fungi form an exceedingly interesting class of plants, the complexity of structure individually being much greater than is generally recognised, whilst the complexity evolved through adaptation to circumstance has resulted in so great a tribe of classes and sub-classes, orders and sub-orders, that very careful scrutiny, oftentimes with the aid of a microscope, is necessary before species can be determined. Nevertheless, there are so many who find pleasure in the beautiful form and colouring of the Fungi, without caring for comprehensive knowledge of the subject, that it will be to some purpose if the names of some of the more common species are given, and the reason why such species are divided into separate groups. From the point of view of colouring, taking a few varieties at random from certain classes, one can enumerate examples that are as brilliant as flowers, and quite as gracefully shaded and variegated. They possess, indeed, a range of colour that may be said to exceed that of flowers, since it passes down through orange to shades of tan and russet-brown to mushroom-black.

From the order of the *Russula*, there is *R. Virescens*, with emerald green cap and white gills and stem; *R. Linnæi*, with rose cap and yellow gills; *R. Azurea*, blue cap shading variably to green or purple with white gills; *R. Olivacea*, green cap with crimson rings; *R. Queletii*, purple cap with white gills, whilst *R.*

Nigricans gives entire colouring of deep velvety black.

The order of the *Agaricineæ* can show equally glowing colours, and of these I would mention two specimens that are frequently found together amongst dead leaves, etc., in our woods, viz., *Stropharia Æruginosus*, with turquoise blue cap and pale brown gills, and *Agaricus Violarius*, showing a crimson brown cap, salmon-coloured gills, and white stem.

Quite as wonderfully varied as the colouring is the exterior form of the Fungi. For here the range extends from the great Horse Mushroom of the *Agaricineæ*, or the coarse saddle-shaped forms of *Polyporus Squamosus*, down to the most fragile and minute species such as *Marasmius Hudsoni*, that lives on dead holly leaves. It measures about one inch in height, and curiously produces in miniature the suggestion of the holly's spines both on cap and stem. *Agaricineæ Setosus* will erect a crowd of delicate white pin-like forms only half an inch high on a single beech leaf. When we consider that every form of rust and mould, whether on the wheat-ears in our fields, or associated with food in our larders, is essentially a variation on the Fungus principle, it will be seen how large a family this is in its root-stock.

The development of species, or extension from any specialised manifestation, seems always to be the result of its capacity for adaptation to circumstance. The primitive *spore* became an extended and diversified manifestation according to the particular law of its circumstance. The original idea, persisting by right of its inherent life-power, is, nevertheless, conformed by the changed environment, and new variations of form, colouring, and structure are the consequence. Right at the heart of every expression of Nature there is always this great law at work—that of adaptation to circumstance. In short, to be able to conform to that is to be; to fail, is not to be.

There is no form of the Fungus order of plants, or, indeed, of any other plant or organism, but expresses this truth in itself very distinctly.

The Fungi belong to a very marked division of the order of plants. It is, indeed, so marked that some people scarcely think of the familiar Toadstool or Mushroom as plants at all. There is no point in all Natural History more interesting than the one where is discovered the emergence of one type-form from another—in other words, the link showing a vast relationship.

Deep down in the complexity of specialised form is also the warrant of relationship to the family-tree of the universal. Associated with that division of plants called *Cryptogams*, the Fungi are conspicuously separated by the absence of chlorophyll, or green colouring matter, in their constitution. This characteristic separates them from other plants, since it determines and limits their existence—they must feed upon organic matter, and not inorganic. The inorganic properties of clay, lime, etc., must have been first assimilated by another organism and transformed into chemical constituents nearer to the nature of the Fungus itself.

The two great divisions of the tribe are respectively: 1, *Saprophytes*, those that live on dead organic substances; 2, *Parasites*, those that live on living plants and animals. The fact of this subdivision shows at once what great power of adaptation to circumstance the Fungi principle possessed. Some regard them as descended from the *Algæ*, the primitive cellular plants that have been divided into three groups: 1, Algæ; 2, Fungi; 3, Lichens.

It is stated that these last became differentiated at a later period than the Fungi, being met with in fossil state in Tertiary rock, and having persisted ever since.

Two main groups divide the Fungus family: 1, *Ascomycetes;* 2, *Basidiomycetes*.

The first is the elder in point of time, showing in the organisation a closer resemblance to the *Algæ*, the old universal ancestor. It is from this ancient order of the *Ascomycetes* that the species shown in the illustration on page 241 is descended. The other seven specimens illustrated all belong to the group of the *Basidiomycetes*. Since the determination of species depends upon the structural formation, a little should now be said upon this important matter.

The general construction of the *Hymenomycetes* may be considered from the appearance of the well-known Mushroom as a type, the organisation and reproduction scheme being the same. This class includes nearly all the larger Fungi, the name having reference to the plant possessing a fruit-bearing surface. The Fungus possesses: 1, *Mycelium*, or body; 2, *Receptacle*; 3, *Reproductive organs*.

THE FLY AGARIC.
Common in Birch and Fir woods. The cap is at first blood-red in colour.

The flesh-coloured gills of the Mushroom have the *Hymenium* or fruit-bearing surface spread over them in the earlier stages of its growth. Upon that surface are the *sporophores* which bear the *spores*, or seeds; generally four in a group, and possessing rudimentary stalks. These *spores*, when germinated, produce again a *Mycelium* possessed of the same apparatus.

All the classification of Fungus types is very commonly determined from the character of the *spore*.

In the genus *Agaricus* there is division into five series, determined by the colour of the *spores* as white, pink, brown, purple and black. The white-spored species are the highest in type—firmer and more persistent than those having coloured *spores*. With the last-named there is a tendency to collapse easily, especially in the case of the black *Agarics*. As compared with other plants, the Fungi present a singular phantasy of being, possessing often an ephemeral existence largely characterised by the matter from which they are expressed. Sometimes one species is found preying upon the decaying substance of another, such as the slender silver-grey *Nyctalis Parasitica*, with long curving stems springing from a stout russet-brown variety of *Agaricus*.

Without going further into the profundities of the construction and exterior character of the *spores* themselves, the under surface of the Fungus must be considered. The character of the gills, or *Hyphæ*, as they are termed, is most variable, and forms definite class distinctions.

In the *Agarics*, and allied types, the gills are of loose flexible character, whereas in the perennial Fungi they become very densely compacted, sometimes cork-like, or even hard as wood itself. Other species, again, have a granular liquid secreted in the *Hyphæ* resembling milk, from which fact the genus is called *Lactarius*.

The character of the stem, or *stipe*, the absence or presence of the ring upon it, the margin of the cap, or *pileus*, and general shape, the quality of its flesh and colouring beneath the outer pellicle, are all matters of consequence in classifying species. The stem may be solid, semi-solid, or hollow, possessing a bulb-like base, rootlets, or a long tap-root.

The first illustration gives a good idea of the Fly Agaric, classified as *Amanita*

Muscaria, or *Agaricus Muscarius* (Linn.). The former manner determines the additional fact of the species belonging to the *Amanitæ*, a sub-division of the large order of the *Agarics*.

THE "SCARLET HOOD."
Common in grass. The cap is scarlet above, shading to orange and yellow below.

It is a very showy plant, and common in our birch and fir woods. The *pileus*, or cap, is a vivid blood-red at the first stage of expansion, becoming more orange later, and paling in colour when old. Its early form is globose, then convex, and lastly flattened, with fragments of the white *volva*, or universal wrapper, scattered on the surface. Beneath the outer skin the flesh is white, together with the stem, which at an early stage is filled with fibrils, but soon becomes hollow. The base is bulb-like, with rings of scales running round it. The "ring" is large, soft, and torn in shape, inserted at the apex of the stem and hanging down upon it. The illustration unfortunately fails to show this ring owing to the surrounding mosses. The gills are what is termed free in character, but touch the stem; the colour is white, though rare instances of yellow may be met with. The average breadth of the *pileus* is from 3 to 7 in.; the stem 2 to 9 in.; although some have written of specimens measuring 20 in. across the cap and standing 3 ft. high.

THE "PRICKLY CAP."
Shown growing on a tree trunk. Its colour is yellow, with bright tan scales.

It is a poisonous species, the narcotico-acid producing intoxi-

cation, delirium and death, although considered less deadly than others of its order. The taste is bitter, and there is comparatively little scent. It is to be found in most districts from July to November.

Commonly known as the "Prickly Cap," the *Pholiata Squarrosa* (ord. *Agaricineæ*) is shown on page 237 in its usual habitat, a tree trunk (frequently an apple tree). It grows in tufts, and appears from August to October, being common to most districts. The *pileus* varies from 2 to 4 in. across, and is tawny yellow in colour; it is very scaly, at first bell-shaped, rounded, then convex when expanded. The top has a suggestion of the central boss, which is emphasised more or less in different species as a variable character. The scales are a bright tan brown and add to the distinctive colouring. The stem measures from 3 to 6 in., is yellow at first, then becomes brown; it is thick, smooth above, and rough below. The ring, seen plainly upon the two topmost specimens, is set high, and is also a bright brown colour. The interior of the stem is fairly solid and of pithy construction. The gills change in colour, being yellowish in the early stage, olive-coloured later, and eventually brown; they are unequal, and bow-shaped in form; the *spores* are brown. Regarded as a wholesome species, the "Prickly Cap" cannot claim to be of first-rate quality, the taste being rather that of mouldy meal.

BOLETUS VARIEGATUS.
To be found chiefly in Pine woods. Dark yellow in colour.

The "Scarlet Hood," or *Hygrophorus Coccineus* (ord. *Agaricineæ*), is another common species, frequent on grassy places in scattered groups from August to November (see page 237). The *pileus* measures from 1 to 2 in. across, and is scarlet above, shading to orange and yellow below. It should be remembered that the colouring of the Fungi is variable, and the gills may even assume a pinkish tone. The cap is conical, bell-shaped, slightly bossed, and when expanded sometimes splits from the centre. The inverted specimen on the left of the group shows the formation of the gills excellently. The principal difference from all other allied species lies in the *hymeneal* stratum of the gills becoming a waxy mass removable from the *trama*, a substance existing between the two plates of the gills. It is specially noticeable in this species, the gills seeming full of watery juice. They are yellow or red, broad and swollen in the middle. The *spores* are white; the stem, from 1 to 2 in. high, is yellow streaked with scarlet; thick, smooth, tough, yet easily split, and hollow in the centre.

The species is edible, has no scent, and is of good flavour.

Boletus Variegatus (ord. *Polyporeæ*) is a species found chiefly in our pine woods through September and October. The *pileus* is 3 to 5 in. broad, dark yellow in colour, and in form convex, then flattening; it is slightly moist, and sprinkled with small hairy scales. The

stem, from 2 to 3 in. high, is thick and firm. The colour is dark yellow and sometimes reddish. The tubes are unequal, with the pores minute, brown at first and then cinnamon.

The reversed specimen in the illustration on p. 238 shows these fine pores as suggestive of pin-pricks, covering the entire under on this page, one can more easily recognise that the *pileus* is of intricate construction, the curled edge being waved in outline, and in addition re-curved upon the *pileus* itself. *Dædalea* expresses the idea "curiously wrought." This complex border of the plant even becomes torn into jagged teeth. The colouring is a very beautiful variation of

DÆDALEA UNICOLOR.
Commonly found on tree-stumps—particularly Birch. Ash-grey in colour.

surface of the Fungus. Although generally regarded with much suspicion as a poisonous "toadstool," it is in reality one of a large species of wholesome Fungi. The size and abundant growth of the *Boleti* provide a considerable quantity of food that is ignored, to the great regret of those who have largely explored the question.

In *Dædalea Unicolor* (ord. *Polyporeæ*) we have a very distinct departure in growth and general appearance, yet a species maintaining the principal character of its order among Fungi in the manner of the fruit-bearing surface lining the interior of tubes or pores. Looking at the isolated specimen to the left of the photograph ash-grey with white extensions; the *hymenium* is whitish grey, while a section shows a greenish colour. The *pileus* exhibits zones, or rings, of the same colour, with variable shading. It is commonly found on tree-stumps—particularly birch; and also, as in the illustration, growing over the mosses and dead *débris* of the woods.

The isolated specimen also shows very clearly the character of the under surface, and the tubes wherein the *spores* are expressed.

Stereum Hirsutum (ord. *Thelapherei*) is a plant familiar to everyone, for it is to be seen practically all the year round growing on decayed tree-stumps. The base, or part nearest the stump, is fre-

THE "PUFF-BALL."
Dirty white in colour, changing to brown.

TEREUM HIRSUTUM.
Grows on decayed tree-stumps.

quently greenish, passing into a pale ochre border, with fine brown lines upon the upper surface, marking zones. In the early stage of growth the plant does not show the hairy character. The margin is blunt, sometimes a clear white colour, when the stump appears to be elaborately

or rarely single, the *spores*, when ripe, forming a mass of powder. The photograph on p. 240 shows the various stages of growth—from the early globular form to the more pear-shaped one, giving the distinctive title of *pyriforme* to this species.

At first the Fungus is covered with

XYLARIA HYPOXYLON.
Shown growing on moss on a Beech stump.

decorated with braiding. The surface is wrinkled and reflexed, and the *hymenium* beneath even, smooth, yellow in colour, and without juice. It is a perennial species mostly, coriaceous or woody; the *pileus* is leathery, and generally 3 to 5 in. across, being arranged in close groups one over the other in tile fashion.

The "Puff-ball" species, *Lycoperdon* (ord. *Gastromycetes*), belongs to the second of two main groups dividing the *Basidiomycetes*, viz., *Hymenomycetes* and *Gastromycetes*. The construction of the *hymenium* of Group 1 has already been dealt with; in Group 2 this fruit-bearing surface is enclosed until the *spores* are ripe and ready to be dispersed. The *Lycoperdeæ* form one of the seven sub-orders. The skin, or *peridium*, is double, minute pointed warts that give a frosted appearance to the surface; later, they disappear before the bursting of the ball, which takes place from the mouth indicated in the large specimen at the right-hand base of the picture. It is an edible, rooting species, possessing long white branching fibres. The colouring is dirty white changing to brown, the flesh dingy white transformed later into the brown dust of the *spores*.

The curious-looking growth of tooth-like forms upon the moss shown on this page represents a common species descended from an ancestor older than any of the preceding illustrations. It is the one example given from the primary group of the *Ascomycetes*, all the remaining seven being descended from the *Basidiomycetes*.

The *Xylaria Hypoxylon* (ord. *Sphæriaceæ*) is corky in substance, and is either simple or branched. The photograph shows a growth, in the right-hand top portion, branched distinctly into three, as well as many examples of the simple form. The branching extends considerably beyond this, the group representing the plant in an early stage of growth; it is then pulverulent on the surface, having a white mealy powder upon it, which later on disappears and the colouring becomes black.

The black base is clearly distinguished in the foreground group to the left of the picture, where the tree-stump is sliced off at an angle. The two leaves in the immediate foreground are of value in suggesting the size of the Fungus. In the stages of its growth, the *Xylaria* expresses something of the advancement of all plant growth onwards from a primitive, or very simple blunt form, to the more complex one of extended branches and branchlets upon those branches. In the simple blunt form that first arises there is a conglomerate of cell-structure that, becoming checked in its direct upward growth, forces again forwards laterally and vertically as two or more distinct portions. These in their turn repeat the impulse, adding to the character of the plant.

MAUD U. CLARKE.

LIFE HISTORY OF A MOUNTAIN—I

By J. LOMAS, F.G.S., A.R.C.S.

THERE is a group of insects—the Ephemera—whose lives are compassed about by a single day. In the morning they are born, during the day they go through all the functions of life, and die with the setting sun. Imagine one of these creatures, endowed with powers of thought and reasoning, spending its brief existence on an oak tree. Of its own knowledge what could it know of the acorn, the unfolding leaf, the bare branches and winter's snow? It would naturally regard the oak tree as the very emblem of stability—immutable and everlasting.

So man, when he considers the Earth on which he spends his little day, would be prone to look upon the features of the Earth's crust as unchanging, if he were guided solely by the light of his own experience. Even if he were acquainted with the accumulated experiences of past generations as recorded in the writings of his predecessors, the changes would be so slight that they would scarcely be noticeable.

But the Earth has written its own story in the rocks of which it is composed, and if we can read only a little in this great "Nature book" we find that the dominant note is not stability, but change.

Mountain, valley, river and sea are only the present-day phases of many scenes which have begun and ended in the past. Tennyson's well-known lines record a scientific fact:

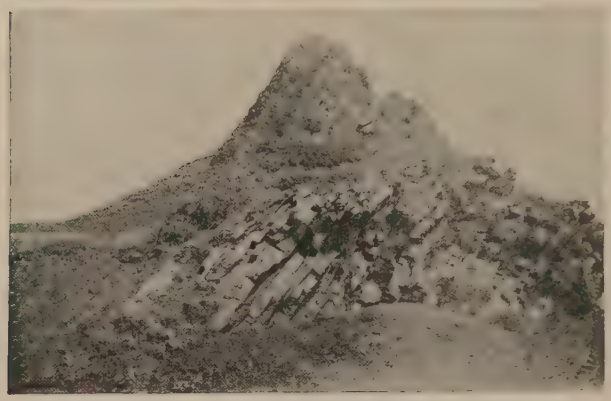
> "There rolls the deep where grew the tree,
> O Earth, what changes hast thou seen!
> There, where the long street roars, hath been
> The stillness of the central sea."

In the great operations of Nature, *time* is an important factor. Changes may be going on about us with such exceeding slowness that we do not perceive them. In our blindness we speak of the "everlasting hills" and "the ever-changing sea," and yet by a strange irony the sea-level is the only datum line which can be regarded as approaching to stability, and it has been universally employed as a means of recording the height of the land.

"MOUNTAIN, VALLEY, RIVER AND SEA ARE ONLY THE PRESENT-DAY PHASES OF MANY SCENES WHICH HAVE BEGUN AND ENDED IN THE PAST."

Buttermere.

It has been found, however, that it would not do to use mean sea-level indiscriminately and at any place as a starting point, and so the Ordnance Survey in preparing the maps of our country were compelled to adopt a certain line, which they considered, after careful and prolonged observation, to represent the mean sea-level at the Old Dock Sill at Liverpool.



"THE STRATA . . . MAY BECOME TILTED INTO AN INCLINED POSITION."

It may be asked, by what signs do we know that the Earth's surface is subject to changes of level ?

In many parts of our coasts, and more particularly on the west coast of Scotland, we meet with low platforms extending seawards from inland cliffs. In all respects they are like the beaches now being formed on the shore. The sands and gravels of which they are composed contain the remains of marine shells ; yet they are never covered by the highest tides, but stand high and dry twenty-five to fifty feet above the present sea-level. In other countries ancient beaches have been raised to a height of many hundreds of feet.*

While these may be looked upon as proofs of the elevation of the land, forests of oak, poplar, pine and other trees which are now submerged under the sea at high water, convince us that the land has been depressed in other parts of our coasts.

On a grander scale we find ancient sea deposits among the highest peaks of the Alps and the Himalayas. We cannot stop to inquire when and how these great changes took place ; it is sufficient for our purpose to know that the Earth contains within itself forces sufficiently powerful to crumple the Earth's crust into ridge and furrow, and continent and ocean alike bear witness to the vast energies existing, but not slumbering, beneath our feet. In the gradual exercise of these energies mountains have their origin.

In tracing the history of a mountain, let us assume that the sea bottom is in process of gradual elevation.

The infant mountain has scarcely emerged above the waters before it is subject to forces from the outside which tend to reduce it to a lower level. During growth these same destructive agents are at work, and they cease not when it has attained its full stature and strength.

In the end they prevail, and the mountain is once again removed into the midst of the sea to form "the dust of continents to be."

Thus, like most of the operations of Nature, the events run in cycles, and return to the point from which they started.

In considering the cycle of events through which mountains pass, we must keep full in view these two conflicting elements : one working from within tending to uplift, the other from without tending to destroy.

The character and disposition of the material on which these forces play are also important in determining the form which the mountains assume.

Some rocks, such as granites, have been solidified, by cooling, from a state of fusion. They are usually compact and homogeneous, and offer few points favourable to attack. Their weakness chiefly lies in the cracks and joints, which develop as the mass shrinks, and they are susceptible to chemical decay.

Other rocks such as sandstone, limestone, shale and slate are commonly laid down in layers or strata. It is seldom they preserve the same characters through

* *See* "Waves and Their Work," p. 221.

"BENT INTO FOLDS WITH CRESTS AND TROUGHS LIKE THE WAVES OF THE SEA."
Sawley, near Clitheroe.

"CRUMPLED UP LIMESTONE BANDS."
Foxley Bank, near Clitheroe.

THE GRANITE PINNACLES OF THE MOUNTAINS OF CORSICA.

any considerable depth, but show alternations of strata with varying degrees of resistance. It is a common saying that the strength of a chain is the strength of its weakest link. The same holds good with rocks of this class. A layer of soft yielding shale interbedded with more durable limestone or sandstone may cause the whole to decay as rapidly as the shale itself.

As a rule, the strata are laid down horizontally, but in the process of mountain building they may become tilted into an inclined position or bent into folds with crests and troughs like the waves of the sea.

It has been proved, experimentally, that many rocks which would break with a sudden blow will bend if the pressure be applied very gradually and continued for a long time. Hence we do not postulate that a sudden or violent force has crumpled up the limestone bands shown in the photograph on page 245, but rather a gradual pressure lasting through immeasurable time.

If the distorting forces act more rapidly, we get fracture instead of bending, and great blocks of rock, sometimes miles in extent, may slide over each other along the line of breakage. Displacements of this nature are called "faults."

The grinding of great rock masses over each other also results in other effects than mere displacement. Vibrations are set up in the adjacent rocks which produce the phenomena of earthquakes. As many thousands of earthquakes occur in the Earth's crust every year, and each one of these results from the fracture and slipping of strata, we see that the Earth is still subject to great stresses, and is constantly accommodating itself to them.

Now let us consider the external forces whose office it is to degrade the land.

"MASSES OF GRANITE MAY BE SHATTERED INTO FRAGMENTS AND LIE ABOUT, A PICTURE OF RUINOUS DECAY."

Frost, sun, rain, river, glacier, sea and wind are the principal agents of destruction.

A mason in sculpturing a block of stone begins by chipping away flake after flake until the desired shape is roughly attained. Then he uses finer tools to produce more detailed outlines, and the final effects are secured by polishing.

So in rock sculpture—frost and sun do the roughing out, and the other agents principally act as finishing tools.

The effects of frost are mostly felt in high latitudes and at great altitudes. We know from personal experience the effects of water freezing in our domestic supply pipes. We may not discover that the pipe has been broken until the thaw comes and the water floods our dwellings. In the same way, the water contained in the crevices of rocks expands on freezing, with almost irresistible force, and shatters even the hardest material into fragments; the flakes are held fast until the spring comes, and then the *débris* rains down to form a talus of stones at the base of the slope. We see the work of frost-flaking in the granite pinnacles or aiguilles of the high Alps, the mountains of Corsica,* and in all compact rocks subject to great cold.

In our latitudes it is hard to realise what sun-flaking means, but standing under the tropical sun, and face to face with the riven rocks, it becomes very real. During the day the stones become intensely heated and expand; at night, when the sun's rays are withdrawn, they rapidly chill and contract. Thus by alternate expansion and contraction even masses of granite may be shattered into fragments and lie about, a picture of ruinous decay.

The agents engaged in finishing the work roughed out by frost and sun are more influenced by the texture of the material on which they operate. The softer parts rapidly decay, leaving the framework of harder rocks standing like a bony skeleton stripped of its covering flesh. Moving water, ice and air can do little of themselves. It is the harder material they carry in suspension which

"LEAVING THE FRAMEWORK OF HARDER ROCKS STANDING LIKE A BONY SKELETON STRIPPED OF ITS COVERING FLESH."

* See also the coloured plate of Mr. MacWhirter's picture, "June in the Austrian Tyrol," in Part 3.

is really effective in abrasion and polishing.

We have seen that moving water in the form of a river can cut gorges and excavate wide valleys. The sea, when lashed into great waves, not only hurls huge masses of water against the cliffs, but bombards the rocks with showers of stones; it is these missiles which drill caves and isolate stacks.

When we come to discuss valleys we shall see how important are the effects of moving ice in moulding the contours of the land. In some parts of our own islands the tool marks of ancient glaciers are still to be seen.

"THE DRIVEN PARTICLES ETCH OUT THE SOFTER PORTIONS."
Sand-etched rocks at Burton, Cheshire.

We can study the effects of moving air in a dusty road or on a sandy beach. The wind catches up grains and flings them against any object in its path. In this way windows of dwellings and lighthouses facing a sandy beach become frosted by the natural sandblast. If the obstacle is not composed of material of equal hardness, the driven particles etch out the softer portions and leave the harder standing out from the face.

By long continued action great rock masses once continuous become severed and expose the interior to denuding forces.

J. LOMAS.

Photograph by G. Bingley, Headingley.

"MASSES ONCE CONTINUOUS BECOME SEVERED."
Brimham Rocks, Millstone Grit.

ANNE HATHAWAY'S COTTAGE.
From the Painting by A. C. Wyatt.

RIPENING TO HARVEST.

THE HUSH OF THE CORN

By ARTHUR SCAMMELL

WINTER evening in Wiltshire Downland. A faint glow at the edge of the flat cloud ceiling in the south-west; home-going rooks in ones and twos and stealthy clusters, slowly flapping their way over the table-land, and sinking downwards to their roosting-places in the trees of the park and churchyard, their Good-night cawing mingling with the chime of the tower clock as it strikes the hour of four.

The long, long stretch of unbroken turf, the virgin pasture of the hills, comes here to an end, and a vast field of upland arable drops in a gradual slope to the valley.

Cold and barren are the winter downs—"High tops bald with dry antiquity"; inch-long grass blades, stunted furze-bushes, and wind-warped thorns, pale ghosts of vegetation, are all that grow there; yet this ploughed land, this desolation of frozen clods and thickly-strewn flints, seems barrenness itself and makes the downs luxuriant by contrast.

And now cold grey fog fills the air, making the twilight weirdness of the scene more weird; and, standing there closed in by those vaporous walls, the wayfarer falls into a kind of maze: he feels as one out of touch with time and space.

This surely is never friendly Wessex soil; rather some "waste land where no man comes nor hath come since the making of the world." A stillness as of the Ancient of Days, before that impertinent accident called Life had appeared, to break, for a feverish hour, the eternal silence: a strangeness as of some far-distant planet where warmth and movement could never be; or some ghostly plain ringed about with the frozen mountains of the moon.

Photograph by Frith & Co., Reigate.

THE CORN-FIELD PATH.

Faint, far-off sounds—the barking of a dog, or bleat from a sheep-fold—though sufficing to set the steps mechanically in motion, do not serve to bring the fancy back from these "wanderings in worlds not realised," and as the darkness deepens, the strange sense of desolation and "other-worldliness" increases.

But suddenly the eye falls upon a tiny spray of green upon the frozen ground; there is another, and another: this seeming barren plain is teeming with new life; thread-like rootlets are striking down to find the waters under the earth; the adamantine crust is pierced by myriads of fairy spears. Straying fancy comes home; the ghostly lunar desert resolves itself into a plain Wiltshire plough-field; and that eerie stillness which had seemed the lifelessness and silence of some far-away planet is but the winter Hush of the Corn.

* * * * *

Again the familiar hills, and the stroke of the clock which has meanwhile marked so many hours of toil and rest for the village below. Again the edge of the downs and the beginning of the wheat. But there is no crossing the field now, for midsummer has come; a genial season has favoured the crop, and waist-high spreads the sea of living green: a little scantier on the upper edge of the field, where the plough has thrown the earth downhill, and the stalks spring out of the dry and crumbling chalk; but beyond, as the soil increases in fatness, thickly serried, full, and juicy with a deep blue-green bloom upon curving blade and rigid

stem, stand the noble plants, the finest product of the earth.

In the most backward stalks, where the ear has not fully emerged, the sheath is strong and full of sap; but where, strengthened by a few days'—or, perhaps, a few hours'—exposure, the ear no longer needs protection, the hanging sheath is already withered at the point, the nourishment that had gone to support the blade being, in the perfect economy of the plant, at once directed to the growing grain. Notice, too, how carefully the enclosing husk shelters the delicate process of bloom and fructification now going on, the withered and useless parts only of the tiny florets being exposed to the air.

How prolific, too, is the wheat. An ear of barley consists of two lines of corns in single succession, but the wheat ear is studded on both sides of the stalk with closely packed bunches of four or five corns each—the proper number is five, but the middle corn suffers from overcrowding, and is commonly abortive—so that a single ear will yield from seventy to a hundred grains.

An hour with the wheat. An hour of pleasant lingering, of release from that tyranny of the commonplace which makes us think by rote and act by mechanism; an hour for resuming one's birthright freedom in the great liberty of the Universe.

It is a glorious evening: such an one as flushes the mind with a sense of beauty, and leaves a high-water mark in the caves of memory.

An immeasurable span of sky, its depth of colour just stained at the zenith by a faintest wave of cirrus cloud; a feather cast from some wandering wing of heaven, and floating upwards, too light and pure to fall.

And yet the earth seems well-nigh as clean to-day as the sky; the white chalk soil and the shining green of tree and herb and grass that deck it; the flowers that spring, the flying swallow and the lark, seem all to have put on some of the glory of the sky and air; and the subdued murmur of life which makes the summer air tremulous, sounds grand in the ear, as it were the hum of the great earth spinning upon its axis.

Pass around the field to where, on the western side, the corn is bounded by a grove of ash and sycamore, and there sit in great content, too happy even for castle-building, for what could one imagine better than this blessed reality? And so the hour passes, and another, and the long shadows grow longer and creep across the corn-field and up over the downs, and away into the upper sky, and the glory of afternoon glides into the peace of evening. And as glow and colour leave the sky, and the ardour of the poppies abates, the broad green harmony of the wheat-field more and more entrances eye and mind; dark below, with a soft, pearly sheen above, perfect in mass, perfect in detail; spacious, wide-spreading like the sea, yet homely as the cottage border. The peace of unnumbered ages slumbers upon it. A peace which endures even through the ages of violence: though ruthless deeds may ravage the world, yet the corn-fields will not all be dyed red: the sorrow of many that sow in tears will be comforted by the touch of Mother Earth, and somewhere on quiet hills the harvests of peace will be garnered.

How many sweet associations of rural summer-time are suggested by this tranquil scene: the joy of many generations of poppy-gathering children; the happiness of lovers' evening walks, and the sense of rest which falls with the dew upon the head of the tired labourer; the beauty which rises with the sun, and the tenderness of moonlit hours.

To the continuous chorus of the day succeed the quiet notes of evening, the call of the partridge from the hill—

> "With distant echoes from the fold and lea,
> And herd-boys' evening pipe and hum of housing bee,"

whilst again from the valley comes the sweetly solemn sound of the church clock striking the hour. And the lingering sound of the bell, the closed eyes of the flowers, the dreaming of ancient oaks—

> "Branch charmed by the earnest stars,"

the last brooding note of the dove; all the gentle words and looks whereby the parting day bids Good-night, seem

gathered up and expressed in this perfect stillness of the wheat-field: the summer Hush of the Corn.

* * * * *

Out on the Upland, the August heat of the sun, great as it is, serves in no wise to oppress, but rather to inspire and hearten: the fire which has burnt through the wrappings of the sunflower, and made of its ripening breast a mirror for its own glory; which has kindled the hollyhocks of the garden into living torches, and cast the harmless brands of the poppies amongst the corn, seems to shine with happiness widespread as its light, and to make the glowing air a very elixir of life.

Looking at the long rows of stooks ("aisles" we call them in euphonious Wessex), and at the busy clusters of men and women about the wagons in the field, the thought comes that if only men could be persuaded to live by bread alone—content to satisfy their hunger and starve their lusts—how easy and pleasant a thing life might be made; even the primal imposition of labour proving a blessing rather than a curse.

But the cultivation of the wheat, easy as it is to us who enter into the labour of others, must have had a hard enough beginning.

THE TIME OF HARVEST.

All around the field grow the grasses, now dry and seeded, the poor relations and ancestors of the corn—oat grass, rye grass; their names and appearance are sufficiently suggestive, and we hardly need the botanists to tell us that from one of the humble tribes of these grasses the noble family of the grain has sprung. How we plume ourselves to-day on the skill shown by our gardeners in producing new and strange varieties of fruits and flowers: turning chrysanthemums into dahlias, dyeing the sweet lavender of the scabious with a lurid crimson, and producing weird hybrid fruits, neither blackberry, currant, nor good green gooseberry. But what are these triumphs of to-day compared with this work, done long ages before the dawn of history: this turning of tares into

good seed, this making of bread out of nothing?

The story of the hero who brought fire from Heaven for the service of man has come down to us, but what of the greater than Prometheus who entered into council with the Earth and "the maturing sun, conspiring with them how to load and bless" the sons of men with this gift of gifts?

Was he some savage genius watching, and taking a hint from the bird he meant to snare, as it pecked the seed off the dry grass? Perhaps—and many a savage has no doubt before now made shift to stay his hunger with bird seed—but the prophetic insight, the skill in husbandry, and the patience necessary for carrying out such a tedious course of cultivation and development, bespeak savagery of a noble sort indeed.

Native American legend—by the mouth of Longfellow—tells us the story of the beginning of the maize: how that Hiawatha, son of the West wind, in a time of famine was visited on three successive nights by a beautiful youth, who challenged him to wrestle. Each time the youth was overthrown, and on the third night lay dead upon the ground; but before the final combat he foretold the issue and bade Hiawatha bury his body and watch and tend the grave. So Hiawatha laid him in soft earth and uprooted the weeds, and scared away marauding birds and animals—

> "Till at length a small green feather
> From the earth shot slowly upward,
> And before the summer ended,
> Stood the maize in all its beauty,
> With its shining robes about it,
> And its long soft yellow tresses."

Perhaps the savage people which could produce so beautiful a story might, after all, be equal even to this greatest of human achievements—the evolution of Corn.

Photograph by S. H. Wrightson, Streatham Hill.

"THE SLOW-MOVING WAGONS GATHER UP THE LONG RANKS."

On the margin of the field, from a lonely ash is heard the little song of the yellow-hammer. Perhaps the aspect of the scene—a vast expanse of cornland, with never a glimpse of a milk-suggesting meadow—gives an additional poignancy

to the burden of his complaint: "Little bit of bread and *no* cheese."

In the corn yet standing the sparrows are busily taking their toll: poising for a moment and choosing a stout stalk, they grip it with their claws just beneath the ear, and hang sideways whilst they deftly pick out corn after corn. One would hardly suppose such portly little bodies could be sustained by so frail a support, but no doubt these little acrobats are masters of equilibrium.

So the day goes on, and the work. The slow-moving wagons gather up the long ranks, and the great rick in the lower corner of the field grows apace.

Easy the work may seem, but not so easy is it in the doing. Sheaves are slippery things, and to pile a waggon with a towering load so that it will ride in safety, rocking and swaying over rough and hilly ground, is not the work of unskilled labour.

The rick, too, is something of a work of art; the builder uses no plummet and line, and, standing as he does upon his work, has no view of the growing outline to guide him. An occasional call to a "pitcher" on the ground, "How's the rick a'gwain, Thomas: is ur toward or vromard?" "Middlin', Jan: a bit toward, mabbe," is all the help he gets. Yet look at the shapely stacks, especially those that stand on "staddle stones," that cluster round the farms in Autumn: sheer curves of beauty, some of them, and well deserving the crowns of plaited straw with which old-fashioned thatchers used to top them.

The field is large, and night falls with the crop ungathered. The labourers ride home in the wagons, women and children amongst them, the latter with their little limbs well stubble-scratched; but they have decked their rusty straw hats with bindweed, and carry treasures: perhaps a tiny red harvest mouse or two, wide-eyed and panting with fright, to be the pets of a week.

All are tired, but happy; for though Harvest has no longer the deep significance of old times—expressed in merry-makings and rustic ritual—yet the ingathering of the crops is still, and always must be, felt to be a blessed and happy work.

The call of the moonlit downs draws one out for a ramble. The dew lies heavy, and the cool air of the heights is a draught more precious than wine. How black are the shadows of the furze bushes, how full of mystery the darkened coombs, and all the hill region a very home of romance. If those smooth barrows would but reveal the secrets they hold so closely, and the weather-worn and lichen-spotted stones tell their tale, what stories of earth's wonders and the dim beginnings of man would be unfolded! But with the secret divulged, the charm would be gone; so let the sepulchres remain sealed, and the stones keep that silence of the ages, more eloquent than words.

And upon the corn-field, too, the spirit of the past has laid its hand; reared yesterday, vanished to-morrow, with the caressing of scarcely faded flowers still about them, yet these groups of sheaves seem old as the hills: peaceful tents in which slumber the ghosts of all the ages of agriculture: the health and innocence of the husbandman's life; strength of the men who laboured, patience of women who gleaned; is it not all here? The dewdrop on the stubble, a tear wrung from the sad heart of Ruth; and the cornflower with a deeper blue to-day, caught from the eyes of Highland Mary, as she bound the sheaves for her lover.

Deep and all-pervading is the spell of the moonlit scene, and here the very centre of the mystery: earth and air, the stars, the hills, and the restless heart of man, all held in enchantment by the midnight Hush of the Corn.

ARTHUR SCAMMELL.

HOW TO KNOW THE INSECTS

By JOHN J. WARD, F.E.S.

Author of "Some Nature Biographies," "Peeps into Nature's Ways," etc.

Illustrated from Original Photographs by the Author

CONSPICUOUS INSECTS OF SUMMER-TIME

THERE are many insects that appear about midsummer which attract observation either by reason of their size, or their brilliant colours, or, in the case of some, by their ugly, perhaps repulsive, appearance, and in this paper I propose to deal with insects of this order. My greatest difficulty is to select from the thousands of common British species those which are most likely to be met with, and which will best serve to instruct in the principles of observation of insect life. Having in my previous contributions described in detail a few examples of insect metamorphoses and mimicry, as well as some general distinguishing features, I shall probably not go far wrong now if I deal with insects that more or less force themselves on the observation, when they appear at all.

As butterflies are, perhaps, the most attractive among British insects, we may first consider a very abundant woodland species, the male of which is almost invariably seen displaying his bright sienna or orange-brown wings along the sunlit glades during July and early August. The insect is shown in the first illustration, and is known as the Silver-washed Fritillary (*Argynnis Paphia*). It is, however, the female insect that appears in the illustration; she is more often seen near the ground (the photograph shows her on a stem of clover), occupied with the business of egg-depositing amongst the leaves of the dog violet, and occasionally the sweet violet. Her mate flashes his brilliant colours and endeavours to attract her into the sunny open spaces where they can take long and swift flights together, and then feast on the nectar from the bramble flowers. Both insects have their wings spotted and marked with black, and the female very much resembles the male, only that her brown colour is not nearly so brilliant.

In the illustration on page 257 is seen another example, photographed just in the act of climbing a clover stem. It should be observed that the butterfly has only four walking legs, its fore-legs being rudimentary. This little observation at once gives the information that it is one of the *Nymphalidæ*, and also that in its chrysalis stage it was suspended upside down by its tail end, a peculiarity which we previously noted in connection with the White Admiral Butterfly. This is an instance of the use to be made of the details of classification given in a previous paper which, at the time, perhaps, may have seemed a little unnecessary. I had better add, however, that if this had been a male butterfly, greater care in arriving at our conclusions would have been needed, as in the family *Erycinidæ* the male butterflies have four perfect legs and the females six, and the chrysalides may be raised or suspended; but as there is only one British representative of this family, viz. the Duke of Burgundy Butterfly (*Nemeobius lucina*), this is a point of importance only to the clever and precise critic who, after his wont, might come down upon me had I not modified my statement.

The under sides of the wings are green, and, as the illustration indicates, are conspicuously marked across with wavy bands of silver; hence the insect's popular name. The Silver-washed Fritillary is one of the largest of British butterflies;

it often measures nearly three inches across its expanded wings.

While we are moving about amongst the clover blooms, another brightly coloured insect may often be seen and perhaps be mistaken for a butterfly. There suddenly sounds on the ear a buzzing noise, something like that of a fly, and one or more insects like those shown on the clover-head in the next illustration appear. The photograph gives no idea of the beauty of these insects; their fore-wings are metallic blue or green that glitters in the sunlight, but looks black when seen in shadow, and on each of these dark wings appear five spots of carmine red. The lower wings are of the same red colour edged with a narrow border of the dark metallic green seen on the fore-wings. This insect is the Narrow-

FEMALE SILVER-WASHED FRITILLARY BUTTERFLY.

INSECT LIFE

LIFE HISTORY OF THE SCALY-WINGED INSECTS

Specimens required :—Caterpillars, Chrysalides, Common Butterflies, and Moths

Structure

Examine perfect insects. Note :—

(*a*) *Head.*—Bearing antennae, tube, eyes. Note function of each organ.

(*b*) *Thorax.*—Bearing three pairs of legs and two pairs of wings.

(*c*) *Abdomen.*—Made up of segments.

Take a little dust from wings and examine under microscope, noting *scales.* The scales vary in shape and give the name of Scaly-winged Insects to this group.

Life History

The life history of this highly interesting group should be studied by observing the development of the egg or the caterpillar. These are easily collected. The caterpillars should be fed on their natural food plant.

Note and record the following important points :—

1. Appearance of larva from egg.
2. Change of skin at intervals.
3. Change to chrysalis.
4. Change to perfect insect.

Various species may be fed, and the following observations should be made :—

1. *Ova.*—Shape. Where found. Date of discovery.
2. *Larva.*—Colour. Food plant. Date of emerging from egg.
3. *Pupa.*—Colour. Size. Shape. Where placed. Date of forming. Presence of cocoon.
4. *Perfect Insect.*—Date of emergence.

The following are interesting species for observation :—

1. *Tiger Moth.*—The larvae are found on hedge sides in spring, feeding principally on dock.
2. *Oak Eggar Moth.*—The larvae may be taken on grass in April. The pupa is placed in a hard cocoon.
3. *Emperor Moth.*—The larvae feed on heath in summer. The cocoon is constructed of silk.
4. *Pale Tussock Moth.*—The larvae are found principally on the hop in late summer. The cocoon is placed on the ground.
5. *Peacock Butterfly.*—The larvae feed on nettles in spring. The chrysalis is suspended.
6. *Red Admiral Butterfly.*—This larva may be found in colonies on nettles in summer. The chrysalis is suspended.

LIFE HISTORY OF THE SCALY-WINGED INSECTS.

Fig 1.

Fig 2

Fig. 3

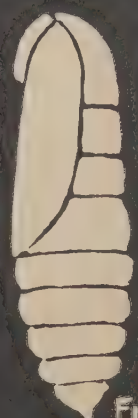


Fig. 4

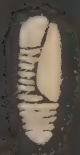


Fig. 5

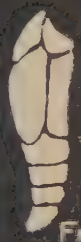


Fig. 6

Fig. 7.

Fig. 8.

Fig. 9

Fig. 10.

Fig 1. Larva of Hawk moth
Fig. 2. Diagram of larva showing segments
Fig. 3 Diagram of pupa " "
Fig. 4. Pupa of Privet Hawk moth.
Fig. 5 " " Currant moth.
Fig 6 " " White Butterfly.
Fig 7 Cocoon of Emperor Moth in heather.
Fig 8 Section of cocoon
Fig 9 Cocoon of Oak Eggar moth.

bordered Five-Spot Burnet Moth (*Zygæna Loniceræ*).

This is a particularly interesting moth for the tyro in entomology to observe, because it apparently offers some contradictions to general rules. In the first place we have here a moth that possesses colours as brilliant as those of a butterfly, and also behaves like a butterfly, flying only during brilliant sunshine and resting during dull days and at night. Moths in a general way are creatures of the dusk and night, but here is one of the many exceptions to that rule. Also, the antennæ should be observed. These, at first glance, appear to be clubbed at their ends, like those of butterflies; careful observation, however, will show that, although they are thickened somewhat, the actual end of the club is pointed, as in all other British moths. The attitude assumed when resting, too, is that of a

FEMALE SILVER-WASHED FRITILLARY BUTTERFLY CLIMBING A CLOVER STEM.

moth. Therefore, these apparent butterflies are only day-flying moths. There are several species of Burnet Moths, such as the Broad-bordered Five-Spot (*Z. Trifolii*) and the Six-spotted (*Z. Filipendulæ*), the popular names indicating the differences in the markings of their wings.

TWO FIVE-SPOT BURNET MOTHS ON A FLOWER-HEAD OF CLOVER.

In the districts where these moths are seen, or have been seen, flying, there will probably be found on the stems of grasses and other plants some of the curious objects shown on this page; these are the cocoons of the Five-Spot Burnet Moth. From four of those shown in the photograph, it will be observed, the moths have emerged, leaving the empty, black chrysalis skins protruding from the tops of the cocoons. Sometimes these cocoons are very numerous, the grasses in some parts of the fields being more or less covered with them. The moths deposit their eggs amongst clover and grasses during June.

Towards the end of August a species of conspicuous yellow and black banded caterpillars will be frequently found feeding, more or less gregariously, amongst the stems and yellow flowers of the common ragwort, as they are seen doing in the illustration on page 259. These are the larvæ of the Cinnabar Moth (*Hipocrita jacobeæ*), which is familiar in June about railway cuttings and hilly districts. The moth is, at first glance, not unlike the Burnets previously referred to, owing to the fact that its fore-wings are dark brown, and spotted and striped with red of a similar hue to that of the Burnets; the lower wings of these moths are also red like those of the Burnets. The wings, however, are larger, and the antennæ are hair-like when compared with those of the Burnet Moths. The Cinnabar Moth, too, is not at all an active insect during sunlight, usually flying during the evening, though sometimes it is seen fluttering amongst the grasses during the day. The larvæ, doubtless, present an instance of warning colours, black and yellow being colours particularly favoured for this purpose: stinging insects such as bees, wasps, and hornets represent

COCOONS OF THE FIVE-SPOT BURNET MOTH.

LARVÆ OF THE CINNABAR MOTH FEEDING ON RAGWORT.

well-known instances. Also, larvæ that produce warning colours often feed more or less gregariously, as by this means they present a greater display of their warning features to their enemies; hence these caterpillars feed boldly in the sunlight, and look quite conspicuous objects amongst the stems and flowers.

Turning from the pretty side of the insect life to the less agreeable, we may glance at the Cuckoo Spit — which I need scarcely say has nothing whatever to do with the cuckoo. This white, frothy mass, which is seen deposited about trees and herbage of all kinds, is purely the work of an insect larva, viz. that of the Frog-Hopper (*Aphrophora spumaria*). The Frog-Hopper itself appears at the end of July, and is a small insect about five-sixteenths of an inch in length, and is possessed of great jumping powers. In the corner of the illustration on this page I have shown the insect at twice its natural size, with its wing-covers partly opened; for these insects are good fliers as well as jumpers. The larva feeds in the mass of froth produced from the juices of the plant, its long beak being plunged into the plant tissues. During the larval stages the insect has no wings, although it resembles in shape the fully-developed insect. In the pupa stage the wings are rudimentary. Finally, it loses its green colour, and develops into a curious insect somewhat like a miniature frog in shape, but possessing pale-coloured, membranous wing-covers bearing large brown spots, and beneath these a pair of ordinary flying

"CUCKOO-SPIT."

At the top is shown the Frog-Hopper, which, in its early stage, produces the frothy substance. The insect is shown twice its natural size.

wings. Its hind-legs possess powerful muscles, by means of which it makes its extraordinary vanishing leaps just as one attempts to capture it. The insect is common everywhere. There is also a much more handsome species known as the Scarlet Hopper (*Cercopis sanguinolenta*) which is frequently seen in gardens. This insect has its wing-covers coloured scarlet and black, and is larger than the common Frog-Hopper.

THE STAG BEETLE.
The largest British Beetle.

On this page another conspicuous insect is shown that can scarcely be placed amongst beautiful insects. The Stag Beetle (*Lucanus cervus*) is familiar in the southern counties after midsummer. It is the largest of British beetles, and the male insect is a blundering, clumsy fellow. As he flies along country lanes, he often comes to grief, for no other reason, apparently, than that one has driven or cycled beneath him. He falls like a stone, and as he lies on his horny back, his legs strike out in all directions; but take care, if you attempt to pick him up, to avoid his large and strong mandibles, for he sometimes bites severely. The female beetle has not the large jaws of the male, but do not let this fact encourage anyone to trust her either, for, although her mandibles are not so large and awe-inspiring, yet they are sharper and meet more closely, and consequently her bite is worse than that of the male. The function of these large and strong mandibles is that of abrading the young branches of trees and other vegetable substances, as a means of reaching their juices. It is in its larval state, however, that this insect is most

injurious. The grub lives within the trunks of trees, feeding on the tissues of the wood, and takes at least three or four years to complete its development.

Having glanced at the largest of British land beetles, we may conclude by a brief consideration of the largest species of the British Water or Diving Beetles.

The photograph below shows a pair of these beetles (*Dytiscus marginalis*). To see some of the beetles in the living state is an easy matter. On the surface of a pond a number of objects may be seen floating like little corks; throw a stone into the water and instantly every one of them disappears. Wait for a while and remain quiet, however, and the objects will, one after another, come back to the surface again, simply because they are compelled to do so. They are Water or Diving Beetles such as those shown in the photograph, or nearly related species, and as they are air-breathers they must come to the surface as soon as their air supply is exhausted. So they float upwards and poke out of the water the tail ends of their bodies to breathe; not that the insects breathe through their tails, but in that position they can take in air under their horny wing-covers. The air is then in contact with a series of little holes called "spiracles" arranged along each side of their bodies, and it is through these holes that the beetles breathe. Indeed they breathe just as other insects do, for insects do not respire through their mouths; even on the body of a caterpillar a row of spiracles will be found on both sides of the body. Thus the beetles become, as it were, diving bells. Now, a little observation of this kind not only teaches how this insect breathes, but, if it be desired to make a capture, it will be obvious that, by waiting until the beetle nears the surface of the water, a sudden swoop with the water-net at that moment will most probably be successful, as the insect cannot return to the depths if its air supply is exhausted. The insects, however, are remarkably quick, and their capture is not easy; a better way to secure them is to drag in the water-weeds and search amongst them. Their wings are large, and as evening approaches the beetles climb the stems of water-plants to expand them. In this way they reach new ponds and seek their mates; sometimes, too, as daylight approaches they are in such a hurry to get back to their aquatic surroundings before their daylight enemies get abroad, that they not infrequently allow themselves to drop like stones upon the roofs of greenhouses and similar places, which from above they have doubtless mistaken, in the twilight, for a sheet of water.

JOHN J. WARD.

MALE AND FEMALE WATER OR DIVING BEETLES.
The male is on the left.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE WALNUT

THIS tree grows to a considerable size, and is both handsome and picturesque. It has marked dignity. From the time of the ancient Greeks, it has been distinguished by the epithet "kingly." Its fruit, also, has been ever greatly esteemed. With us the walnut is mainly a tree of the planted park or garden, though here and there it may be found ranking with the trees of the wayside as in the green lanes of North Devon in the neighbourhood of Porlock. This might have been more general but for the demands made upon its timber for the manufacture of gun-stocks in the time of the Napoleonic wars. It is a distinctive feature in any landscape where it occurs.

WALNUT TREE IN WINTER.

In *winter*, silhouetted against the sky, it is one of the cleanest of our trees, being entirely bare of everything save buds. Dividing into branches rather low down, it throws these out and up with a superb gesture. These branches again divide and subdivide with infinitude of graceful curvature.

In *spring* its leaves expand russet-tinted, and at the same time its green, handsome, pollen-bearing catkins grow out and elongate.

In *summer* its massed foliage, yellowish green, in

TRUNK AND BARK OF THE WALNUT.

multiplied subdivision, completely clothes the tree's framework, forming a symmetrical crown, rounded and dense, and affording a pleasant contrast amongst the greens of this season.

In *autumn* the round, green fruits become evident in small clusters of two or three at the tips of the twigs. Then the leaves slowly assume their yellow to brownish fading tints, the fruits at the same time browning to ripeness.

The *trunk* is strong and round, but usually is short, and divides low down. The *bark* is whitish grey, roughened often into distinctly lattice-shaped markings.

The *winter twigs* are smooth and shining, grey to brown in colour, cylindrical, and rather stout. A distinctive peculiarity of these is that the pith is not continuous, but consists of a series of thin plates dividing the otherwise hollow tube into a number of cells, or chambers, which can be exposed by splitting the twig lengthwise. These twigs externally bear some resemblance to those of the ash, but they can be at once recognised in that the *resting buds* of the walnut are arranged spirally and not in opposite pairs. The buds are thick and rounded, dark in colour, and protected almost entirely by two scales. They stand out on prominent bases. The *leaf-scars* are saddle-shaped, showing three groups of leaf-traces.

The *leaves* are not simple, as are those of all the trees previously considered, but compound. That is to say, each leaf consists of a number of simple leaflets. There are from two

AGED ROADSIDE WALNUT TREE IN NORTH DEVON.

WINTER TWIG OF THE WALNUT.

to four pairs of these leaflets arranged on opposite sides of a central stalk, which terminates in an added leaflet. The veining of the compound leaf so composed is the same in character as that of the simple leaves already considered—a midrib with branching pairs of side ribs. Here, however, the midrib of the walnut's compound leaf takes the character of a central stalk, which terminates at the apex of the uppermost single leaflet; whilst each separate side rib, branching from this central stalk, becomes the midrib of a separate leaflet, having itself numerous pairs of side ribs. A marked peculiarity of these side ribs in the leaflets of the walnut is that they do not terminate in the margin, but curve over, like a whip-lash, looping each into the next. The shape of each leaflet is oval, somewhat pointed, and without marginal indentations. The compound leaf of the ash is similar in nearly every respect to that of the walnut, but the leaflets of the ash are more sharply pointed, and their margins are distinctly and evenly serrated. Walnut leaves are strongly aromatic, especially when crushed.

LEAF-SCAR OF THE WALNUT (ENLARGED).

The *flowers* are separate, but grow on the same tree. They appear with the leaves. The pollen-bearing flowers are gathered into a stout, pendulous, green catkin, growing singly from a lateral bud on the previous year's shoot, unattended with foliage leaves. The terminal bud of the same shoot grows out at the same time into a new shoot bearing foliage, and itself probably terminates with a small cluster of from two to five of the fruit-producing flowers. These are globular, green, bud-like, and erect, each with a pair of purplish plumes, the receptive stigmas waiting for the wind-blown pollen from the pendulous catkins.

LEAF OF THE WALNUT DIVIDED INTO NINE LEAFLETS.

The *fruits* also grow in a cluster, usually two or three, at the tips of the current year's shoots. They are oval in shape, smooth, and in colour green changing to brown. The walnut fruit is not a nut but a stone fruit, the outer fleshy layer of which has not acquired edible qualities, as in the case of the plum or the cherry. When ripe this outer layer splits open irregularly, exposing the "stone" with its hard, bivalve shell protecting the curiously wrinkled twin kernels, held in so high esteem as sweet and nutritious, though by us scarcely regarded as of such superlative worth as to justify the old name—"Juglans," the fruit of Jove.

HENRY IRVING.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," etc.

THE MOLE

With Photographs by the Author

THE existing evidence with respect to the life-history of the Mole is not only conflicting but bewildering. Few wild animals have proved so attractive to the curious, few have so baffled curiosity, and in no case has observation been beset with greater difficulties. We can but conjecture as to the circumstances of his life-cycle. On rare occasions we may encounter him above ground—he has sometimes been observed swimming—a practice for which his paddle-hands and partially webbed hind feet should peculiarly fit him. But, if the only evidence of a Mole's existence were to be derived from such encounters, we should consider him an extremely rare animal, and it would be rash to draw conclusions as to his everyday below-ground habits and appearance from circumstances which, as far as we know, are almost as abnormal as those of the stranded fish.

A MOLE'S FORTRESS SITUATED AT THE ROOT OF A TREE.

The anatomy of the Mole has been minutely investigated, and it might be supposed that a conception of his living appearance, based on such investigations, would be approximately correct. It must be remembered, however, that the anatomy of the Mole is peculiarly aberrant. There are no easily observed forms of life to which we might refer for some standard of comparison, and the difficulty in reconstructing a Mole's characteristic attitudes from his bones and muscles is the difficulty experienced in reconstructing the Okapi. My photographs give, I think, a good idea of the set of a living Mole's limbs, of the texture of his fur, and of his appearance out of his element; but I claim no more for them than that.

The evidence we chiefly rely on in respect to the life-history of the Mole is derived from his earth-works, and these may conveniently be divided into his fortresses, his hillocks, and his runs. All three present interesting and, at present, only partially solved problems.

The fortress appears to have been first investigated by a Frenchman, Le Court. From his notes, which were adopted by Geoffroy Saint-Hilaire, is derived a text-book illustration purporting to represent a fortress interior, and the nest within it, which is probably familiar to many of my readers. The fortress is represented as containing two horizontal circular galleries, one about level with the top of the nest, and one

somewhat higher, which are connected by four or five perpendicular shafts. Runs proceed without at definite intervals from the lower gallery, and there is a single entrance to the nest itself from below.

In justice to this illustration it should be remembered that the original investigator hardly regarded it as the picture of any one fortress in particular, but rather as a type, to which fortresses in general more or less conformed. Generations of writers, however, have accepted it without any such reservation, and although many field-workers must have been sadly disillusioned when they applied to the text-book figure the test of practical experience, they seem, without exception, to have attributed their disillusionment either to personal ill-fortune or to the difficulties inherent in sectioning a honeycombed structure of crumbly material. It was left to Mr. Lionel Adams to approach the difficulty in a scientific manner, and his conclusions, based on sketch-plans of the interiors of about a hundred fortresses, were communicated to the Manchester Philosophical and Literary Society in 1902.

VERTICAL SECTION THROUGH AN EXCEPTIONALLY LARGE MOLE-FORTRESS, SHOWING FOUR NESTS *IN SITU*.

The fortress contained six nests in good order and the remains of a seventh.

So far from the galleries surrounding the nest in a Mole-fortress being designed on any definite principle, and serving as an ingenious labyrinth to baffle the Mole's enemies, Mr. Adams holds, as the result of four years' investigations, that no two fortresses are alike, and that the galleries, which assume haphazard curves and tend in haphazard directions, "*are the natural, incidental, and inevitable outcome of the work of excavating the nest-cavity and piling up the superincumbent mound.*" One could hardly conceive a view more diametrically opposed to that previously held.

As to the haphazard direction of the galleries I am in entire agreement with Mr. Adams. The portion of a Mole-fortress above ground level (the top of the nest is usually about ground level) presents no definite plan, and requires no particular engineering skill on the part of the Mole. So far as a simple fortress with one nest in it is concerned, it may well happen that a single spiral gallery, incidental to the work of excavation, may suffice not only to remove the soil from the nest-cavity and raise a mound of proportions to the Mole's liking, but also to ensure a stable, well-ventilated, and water-proof structure. Where the fortress is complicated, however, and

contains not one, but two, three, and even six nests (as was the case in one vast mound, of which I give an illustration) the pressure of the superincumbent soil becomes a serious matter, and I am inclined to think that the Moles drive arched galleries above the nests, primarily to relieve this pressure, and, secondarily, to secure some kind of drainage away from the nests, and some kind of ventilation. The necessity for the latter will be quickly realised by anyone who keeps a Mole closely confined. It is the repair and maintenance of these galleries (I have found a gallery above the nest as polished as a main run), and possibly also the construction of fresh ones, which causes the external appearance of an established fortress to alter appreciably from time to time.

The reconstruction of a simple Mole-fortress, of which I give an illustration, was effected, so far as the above-ground portion was concerned, by means of drawings to scale, of a series of vertical sections at distances of one inch from each other, commencing on the west side of the mound. Horizontal sections were made at the same intervals for the portion below ground level, and both horizontal and vertical sections were scaled to fixed ordinates. The soil was in a suitable condition for cutting, and I think that the counterfeit may be regarded as approximating fairly closely to the actuality. It must, of course, be remembered that the reconstruction is, in a sense, negative, space being represented by matter and matter by space.

RECONSTRUCTION OF THE INTERIOR OF A MOLE'S FORTRESS.

The nest-cavity is represented by the rough sphere, the tunnels by the surrounding ramification.

The long diameter N to S of this mound at ground level was about a yard, the short diameter about twenty-seven inches, the height about ten inches. These may be considered as fair average dimensions of fortresses in marshy ground. There were eleven exits into the surrounding soil, eight of which can be seen in the picture. These exits were at depths ranging from four inches to eight inches below ground level. There were three entrances to the nest, one at six inches below ground level, the other two at five. The top of the nest-cavity was about two inches above ground level, and the bottom about six inches below. A blind gallery described a winding curve upwards from the nest-cavity. Another blind gallery, with a forked termination, lay

EXCAVATION OF A SIMPLE MOLE-FORTRESS.

Showing the nest-cavity, with nest *in situ*, and an opening in the tunnel used for removing the soil from the nest-cavity.

nearly over the nest cavity and reached within two inches of the uppermost point of the mound.

The dimensions of the largest mound

MOLE DEVOURING A WORM.

I have yet encountered (I excavated it in April, 1907, and give an illustration on p. 266 of one stage of the work) were—long diameter N to S, six feet, short diameter W to E, five feet, height sixteen inches. This mound was pear-shaped, the broadest portion lying towards the south, and the circumference, measured at ground level, was no less than nineteen feet. I have little doubt that it served as winter quarters for a number of Moles—who I suspect are normally reduced by cold to a torpid condition—and I was interested to find last autumn that it had been partially reconstructed. I am at a loss, however, to account for the attractiveness of the site. With regard to the probability of Moles hibernating, it seems hazardous to deny to the Mole any share in that provision of Nature which is obvious in the case of the Hedgehog, and practically certain in the case of the Shrew Mice. Hibernation is a question of food supply as well as of temperature, and, although it is hardly conceivable that the supply of subterranean food within reach of a Mole's burrowing power should ever fail him completely, it must be remembered that the harder the ground is, the deeper the Mole will have to go, the more arduous will be his labour, and the more insatiable his appetite. The depth to which a Mole can burrow is, in many districts, limited by the water level.

One often finds a fresh burst of hillocks after a snowstorm, and such hillocks present a curious, starred appearance, owing to the sudden fracture and upheaval of the snow-crust. Their presence can hardly be regarded as serious evidence against the possibility of Moles hibernating. When the ground is covered with snow the loss of heat by radiation is, to a great extent, prevented, and, other things being equal, a snow-covered meadow in hard weather will provide the Mole with more easily won sustenance than a green one.

It is necessary to draw a distinction between the winter fortress and the breeding fortress of the Mole. I have never found more than one nest in the latter. It is often situated in the im-

A MOLE'S SURFACE RUN LEADING TO WATER.
The run commences at the bottom right-hand corner and turns sharply to the left half-way up the picture.

SOME CHARACTERISTIC ATTITUDES OF THE MOLE.

In the lower left-hand picture the Mole is seen emerging, and in the lower right-hand picture burrowing

mediate neighbourhood of one or more winter fortresses, and may sometimes be distinguished by its relatively small size and freshly worked appearance. The distinction, however, is not invariable. I have taken young Moles from a fortress whose well-turfed surface presented quite a venerable appearance. In such the most frequent nest to be encountered is that of the Humble Bee. I have never found, either in the case of the winter fortress or in that of the breeding fortress, the slightest attempt at concealment of the site, and, with the reservation that my experience has been confined to fortresses situated in soft, swampy ground, I have no hesitation in saying that it is the rule to find Mole fortresses stark in the middle of the meadow, and the exception to find them cloaked in the hedgerow.

THE MOLE.
The normal radiation of the fur round the minute, dull-coloured eye can be seen in the photograph.

It has been asserted that the female alone is responsible for the breeding fortress, and also for the short, winding runs, while the male makes the winter fortress and the long, straight runs. I think, however, that some better evidence than trapping is required to justify these theories, and, until such evidence is forthcoming, the question of their truth should be left open. I have not been able to satisfy myself that either the breeding fortress or the breeding nest present any marked peculiarities of structure. Moles' nests are composed of the most easily gathered material. Should the ground above be carpeted with leaves, the nest will consist largely of leaves; should there be little but grass, the nest will be grass. A grass nest looks as if the animal had simply rolled the material round himself; and a fair imitation of one can be made by holding the two ends of a bundle of coarse grass and circling the hands round each other.

Some interesting information as to the method of the Mole in collecting leaves was recently published in the "Country Side." The author, who has adopted the *nom-de-guerre* of "Gamekeeper," writes:—"It came along one of its shallow runs, through the top of which it would thrust its nose at a likely spot and feel around till it came in contact with a dry leaf—this it would at once detect and seize with its teeth, carting it off, I presume, to the nest-site. Each interval between the seizing of the leaf and the energetic little beast's reappearance was about ten seconds . . . . it never came out further than to show its head and neck."

I have most often found litters of young Moles in May. The young are usually four in number, and the most remarkable feature about them is the extremely large size to which they attain before there is a vestige of fur on their bodies.

With this large size (I have frequently taken young fur-less Moles between three and four inches long) is associated a corresponding muscular development; but the absence of any serviceable teeth shows that the infants are as yet entirely dependent on their mother, and it would seem as if Nature had made careful provision that they should not leave the shelter of the nest before their strength was sufficiently developed to cope with the strenuous life before them.

The very early stages of young Moles present extremely interesting features owing to the light which they seem to throw on the evolution of Moles generally, and on the probable extent of a Mole's powers of sight and hearing. In the earliest stage which I have been able to examine, the eye is decidedly prominent. It stands out from the side of the head like a black pin-head, and measures approximately ·3 mm. in diameter, the length of the head from crown to nose-tip being, at this time, about 5 mm. At a later stage, when the head measures 10 mm. and the eye ·5 mm., the latter has a sunken appearance, and is covered with a membrane which persists until the young Mole is ready to leave the nest. When this occurs the eyes "open" in the usual manner.

In the dead adult Mole the eye is so completely hidden by the fur that the inexperienced may have some difficulty in finding it. In a living Mole, however, who is in good fettle and vigorous (this is seldom the case with Moles caught on the surface), the fur stars round the eye to a breadth of about 5 mm., and leaves the eye clearly exposed as a dull-black pin-head at the bottom of a greyish cone. The Mole evidently possesses the power of radiating the fur round his eyes at will, and the presence of stiff, outstanding bristles in their immediate neighbourhood enables him to determine when such radiation may safely take place. In a healthy Mole above ground the fur is *always* radiated.

The external ear seems to pass through similar phases of degeneration. In the quite early stage there are some signs of a conch, but this soon contracts to a small fleshy protuberance with a slit across it, and, in the adult Mole, the ear-opening can hardly be detected without shaving the fur.

It is further noticeable that the remarkable outward twist of a Mole's hands is a comparatively late development in the young Mole.

A MOLE'S ZIGZAG SURFACE RUN.

All these facts point to the likelihood of the Mole's evident adaptation to a subterranean life having been gradually acquired, and, although it would be risky to base any conclusions as to his powers of sight and hearing on merely external features, the size and position of his eye must, I think, preclude any extended range of vision. The question of his hearing is more difficult, as it can be proved by experiment that the Mole is extremely sensitive to sound-vibrations. It may be found in future investigations

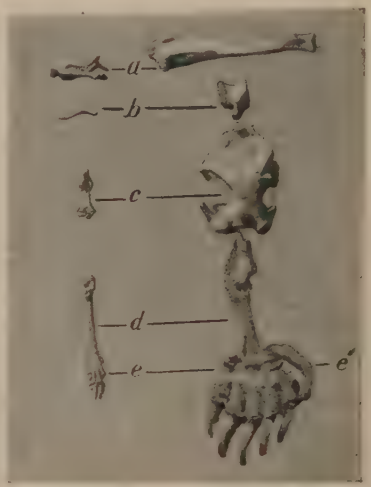
that the internal structure of the ear is so specialised as to compensate for the absence of a conch.

The hillocks and surface runs, which appear in profusion wherever Moles establish themselves, are probably familiar to many who have never had the opportunity of seeing either a Mole-fortress or a live Mole. There are several problems in connection with them which do not appear, as yet, to have been solved. Surface runs will sometimes proceed for several yards without any signs of a hillock, and with only the arching of the soil, slightly broken here and there by pressure from below, to mark their direction. It is in such runs as these, especially those which lead towards water, or to the shelter of some thicket, that it is easiest to trap the Mole. At other times their course is indicated by a succession of hillocks whose combined bulk is out of all proportion to the disturbance of the earth which mere tunnelling would entail.

THE FORE-LIMB OF THE MOLE.

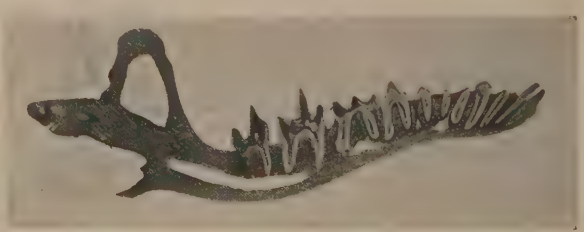
a, Scapula. *c*, Radius.
b, Humerus. *d*, Ulna.
e, Sesamoid.

It must be remembered in this connection that a Mole works like a cylindrical boring tool, and that he employs his hands (as may be seen from their imprints in stiff soil) to compress the earth, which he dislodges with his nose and fingers, against the sides of his tunnel. His progress, a succession of left and right twists and thrusts (sometimes he screws completely round so that he is working on his back), may be compared to the act of boring a crowbar into soft soil. Once he has got his head and shoulders into the ground he quickly disappears from sight without leaving much *débris* behind him. Sooner or later, however, his characteristic hillocks commence to appear. Mr. Adams holds, and I agree with him, that in raising a hillock the Mole is pushing up soil from below with his nose. One is sometimes fortunate enough to see this rose-tipped member while the hillock is in the making; more often, however, one can only see the effect of it. The hillock rises in jerks, often with considerable pauses between them, the earth splitting up the centre and cascading down the sides.



THE SHOULDER AND ARM BONES OF THE MOLE, WITH THE CORRESPONDING BONES OF THE SHREW MOUSE ON THE LEFT FOR COMPARISON.

a, Shoulder blade (scapula). *d*, Lower arm bones (Radius
b, Collar bone (clavicle). and Ulna).
c, Upper arm bone (Humerus). *e*, Hand.
e', Sesamoid.



VERTICAL SECTION THROUGH ONE SIDE OF A MOLE'S LOWER JAW, SHOWING THE STRUCTURE OF THE TEETH AND THEIR ROOTS *IN SITU*.

On brushing aside the earth, which is usually finely pulverised, one sometimes finds a deep, perpendicular down-shaft, sometimes an opening in a horizontal run. I incline to the opinion that the hillocks mean that the Mole is feeding, and that they are composed of the earth which he scratches out at random in the pursuit of worm or insect. If my assumption be correct, we must imagine the Mole to leave his nest when hungry, and to speed along his main runs until he locates by scent some worm or insect. This he scratches out and devours. When his appetite is satisfied he proceeds to tidy up. Should his captures have been effected deep below the surface, he drives a clearance-shaft the shortest way upwards; should he have been feeding from a surface run he rears a hillock immediately above it, or slightly to one side of it. In the latter case one can sometimes catch him by driving the heel down and so cutting off his retreat. Some dogs are extraordinarily clever in detecting the movements of a Mole working close to the surface. A terrier dog of my acquaintance, the best Mole-catcher I have known, had drilled himself to accomplish his captures in three motions. First he would point, with a back glance from the corner of his eye, which plainly asked anyone accompanying him to keep quiet; then he would slowly rear on his hind legs; then he would fling forward, and, I think, pin the Mole with his fore feet. Another second and the poor little "gentleman in black" was flung high in the air. Should this dog happen to miss (he seldom *did* miss), he wasted no time in futile scratching. He knew better.

DENTITION OF THE MOLE.
1. Grinding surface of worn lower molars. 2. Right lower jaw.
3. Upper jaws. The protuberance at the top is the bony cartilage which supports the nose.

The strength of a Mole, in proportion to his size, is prodigious, and the arrangement of the muscles of his shoulder and fore-arm is such that he can exert his maximum strength by the sweep of his hands from a point close to the end of his nose to one well behind his shoulder. Several experiments, made with a view to determining his strength, have been recorded. I have a note of a curious one of my own which had the demerit of being purely accidental. A cage in which I once enclosed a lively Mole had as its only possible exit a half-plate printing frame. The Mole escaped by forcing his way between the rebate and back of this frame. To do this he had to overcome

the pressure of the spring which held one side of the back in position, and the force necessary was equivalent to the weight of $7\frac{1}{2}$ lbs., about thirty times that of the Mole himself. The strength of the Mole can best be realised by holding a full-grown one in one's hand and allowing it to commence boring operations between one's fingers. I have known a young Mole to accompany such boring with a curious clicking noise. I am inclined to think that the noise was mechanical rather than vocal, though I would not go so far as to suggest a ratchet motion!. The voice of the young Mole is a high-pitched squeak, and that of the adult a squeal which is almost pig-like.

I have, on more than one occasion, resorted to my sense of touch to determine the character of the boring by which a Mole drives a surface run in loose soil. I have accomplished this by noting the direction in which a Mole is travelling, and pushing a finger deep into the ground to bar his progress. The first sensation experienced is the screwing of the Mole's nose. Then one feels the nose slip forward and the claws of one hand brought to bear with extraordinary force. Finally one feels the Mole's teeth. It is possible, of course, that the Mole may mistake the finger for a prodigious worm, but, from the nature of the cut which his teeth inflict under these circumstances, I think that progress rather than feeding is in his mind.

Every part of the Mole is modified to suit the conditions under which he lives, but his teeth, the bones of his shoulder and arm, and his hair, present features of peculiar interest. A Mole's hair is almost identical with that of a Shrew Mouse, and we will consider it in the following article, noting now only the peculiar difference of coloration which it presents, accordingly as it is stroked from head to tail or from tail to head. The latter gives the rich characteristic black velvet, the former a soft sheen of indigo.

The shoulder and arm bones of the Mole are of an extraordinary character, and the bone of the upper arm (*humerus*) is one of the most aberrant bones known. In the case of most animals (including ourselves) the *humerus* is typically "bone-shaped." In the Mole, however, the *humerus* presents a form of which I think my photographs will give a better idea than any attempt at a description. The collar bone (*clavicle*) is almost equally peculiar, and the shoulder-blade (*scapula*) presents an exceptionally long area for the attachment of the great shoulder muscles. The massive character and interlocking of the two bones of the fore-arm, and the modification of the hand by the sickle-bone (*sesamoid*), which makes an effective spade or fork of it, according to the opening or closing of the fingers, can be seen in the illustration. Remembering that the massive character of these bones is well matched by the massive character of the muscles attached to them, the reader will be able to realise the immense strength which the Mole can exert with his fore-limbs.

The Mole possesses forty-four teeth, and the points in which the molars differ from those forms which we have already considered can be easily seen in the photographs. The back teeth of insectivorous animals are pre-eminently well adapted for dealing with hard, slippery, and wriggling material. A nip with two opposing rows of them will pin any creature which lies within their sphere of action in twelve different points; a bite will cut it into twelve different pieces. Thus a worm or insect is comminuted rather than ground by the Mole's teeth, and once the Mole has a grip of him his fate is sealed. In eating an earth-worm the Mole's evident intention is to trap a considerable portion of it lengthways in his mouth, and not across it. He bites, like a Shrew Mouse, first with one side of his jaws and then with the other. He commences by holding the worm between the in-turned sides of his hands, and draws one end of it up between them with his teeth, a process which no doubt gets rid of much of the slime-coating. The part of the worm between his teeth and hands is stretched taut, while the part beyond his hands wriggles miserably. I have sometimes seen a Mole make a series of little nips along a large worm before he attempted to eat it. No doubt this action serves in some way to cripple the worm, but the crippling is not very obvious.

DOUGLAS ENGLISH.

Photograph by F. Mason Good, Winchfield.

THE ROCK GARDEN, HARTLEY GRANGE.

ROCK, WALL AND WATER GARDENS

By H. H. THOMAS

THOUGHTS of one invariably conjure up pictures of the others; the rock garden is incomplete without its pond, pool or rivulet, and the water garden, although not wanting in intrinsic charm, gains in picturesqueness if here and there its ripples wash bold, rock-studded shore. The rock garden is the most difficult of all gardens to make. Unless one works in the closest touch with Nature, and takes for model one or more of her own exquisite examples, the natural will inevitably be subordinate to the artificial, and when the work is complete it may be found that instead of a rock garden one has made merely a rockery. I write slightingly of a rockery, and I think with good reason, since there is rarely an excuse for its existence; in other words a rock garden might well have been made instead. The making and planting of a rock garden might be included among the fine arts, but the building of a rockery is a work that demands no skill, no taste, and little knowledge of the ways of plants. The rockery is a jumble of stones or clinkers or bricks and soil and plants; there is no good reason for the presence

of the latter, since they would grow just as well anywhere else—in the garden border, for instance, they would probably thrive far better. The rock garden proper is a home for Alpine plants, and it cannot be said with truth that they would be as happy elsewhere. It is a home for mountain flowers, for fragile blossoms, must bestow upon them such care as Nature herself expends on her own wild hill-top blossoms.

One must have spent lone hours among the hills and dales, the rocks and rills, in winter and in summer, ere one can know the ways of rock garden plants. Their likes are so subtle and their dis-

Photograph by F. Mason Good, Winchfield.

ON THE TERRACE, HOME PLACE, LIMPSFIELD, SURREY.

for those that love sun and others that love shade—a garden in the best conception of the word, a place where the likes and dislikes of each plant may be studied and its needs fulfilled. In the whole realm of garden flowers there are no greater sticklers for aspect and position than these exquisite Alpine blooms from the rocks, the margins of mountain rills, from snow-bound peaks, and to succeed in growing them is perhaps the highest expression of the gardener's art. One must know not only how and where they grow, but the kind of soil in which they grow; beyond and above all one likes so pronounced as to appear inexplicable, until one has solved the secret of their wayward lives. One must grow them, and by tender, constant care, by veiled experiment, by the subtle practise of one's deepest knowledge, endeavour to find the key to their cultivation. And here it is that actual experience tells. Your neighbour may grow some lovely Alpine flower to perfection, and give such explicit details of management as almost to embarrass you; yet, carrying out his instructions to the letter, you fail. It seems as though some of these tiny plants delighted to baffle the would-be grower, for they

insist that each shall find for himself, by experience, just how and where they delight to grow. And shall one blame them? The more exacting they are the greater is our delight when the secret is solved, and as a consequence the more tender our care of them.

Yet thus it is that for every rock garden one sees there are hundreds of rockeries—where scarcely the lowliest and least fastidious of mountain flowers will deign to grow.

In planting the rock garden it is best to turn for lessons to Nature's vast wild garden, for their variety is limitless, their capacity for teaching is inexhaustible. Here, the more one learns the more one finds there is still to learn. One must first appreciate the glamour of the rock garden, for it has an idealistic as well as a practical aspect, and even to the gardener perhaps the one is as important as the other. The charm of the rock garden depends upon its approximation to Nature's planting of the mountain chains, the Alpine peaks, the rugged waterways, the lonely, wooded heights. See there how Nature sows and plants and tends her tiniest flowers, and Time, the hoary gardener, throws a halo over all. There, and there only, is it possible to learn, and all unconsciously, how the spirit of the leaves and flowers pervades the grandest rock garden of all. Take a lesson from the heather-covered slopes —carpets of purple bloom when summer wanes, from the huge moss and lichen-crested boulders that appear to have stopped suddenly in a headlong course down the mountain side, from the regular succession of rocks watering with marvellous precision the tiny plants that cluster round them; aye, and more than all these things, let the poetry of the landscape make its appeal to you. For there is poetry even in the wildest of Nature's wilds, in the play of light and shadow from hill-top to valley, in the music of the mountain streams, in the gaunt, grey rocks, the sombre pines, and above all in the wondrous variety of her leaves and flowers.

At the moment, perhaps, one fails to realise that such an appeal can help one as a gardener, but in the fulness of time that realisation will come. Its practical value may never come home to you; you may exercise it unconsciously, but the ineffaceable memory from which inspiration springs must have an influence on your work. As the rock garden grows under your care it will be more or less natural, according to the depth and the poetry of the inspiration derived from those lone days and hours among the wilds of Nature's own rock garden of the hills. No true gardener, and above all no true rock gardener, can stand unmoved among his favourite plants as he sees them growing in full beauty and perfect association, amid the sublime grandeur of their Alpine home. On peaks unclimbable, clinging as if for very life on giddy precipice, yet more than safe, painting the ground with great patches of brilliant colour that rivals the cloudless sky in its depth of tone, springing from mossy bed on the shady side of some massive boulder, or nestling cosily in the shelter of mountain scrub, they thrive and bloom as though the very world were one of blossom, and all must play their part. And when the glory of sunset spreads and the snow is stained with the Alpen-glow, an added glamour touches them, a beauty that is scarcely theirs possesses them, and the subtle charm of the mountain flowers comes home to one. When working in the artificial rock garden one lives again those days among the Alpine flowers in Alpine lands; the memory of that enchanting time fills one with a deep longing, and a sense of real delight.

But what of rock garden plants? Ah! bewildering variety, incomparable beauty! They come from Scotland's misty moors, from Wales' dew-laden heights, from the sublime fastnesses of the Himalaya, from the Alpine lands of Europe, and far continents. Thus who shall tell how and what they are? I should not care to try. But some there are that must be named, since if one would make a rock garden only the most accommodating must be chosen at first. The Alpine Pinks, neat little tufts that are ever-grey rather than evergreen, are indispensable in early summer time; flowers of white or rose or pink bedeck the leaves, hiding the rock surfaces on which they love to grow. Then Bell-

flowers, chiefly in shades of blue, Alpine Primroses, preferring shade to sunshine, Silenes, Rockfoils or Saxifrages in endless variety, Rock Cresses and Candytuft, Snowflakes and Snowdrops, Windflowers or Anemones, Crocuses, Squills, Irises and Alpine Asters, are some that are least inclined to protest at irregular treatment. Fortunately it does not follow that the flowers most difficult to grow are those most beautiful; the least exacting make a rock garden of captivating charm. Of plants that delight to spread over sun-scorched stony banks, and hang a fringe of flower and foliage across unshadowed rocks, are the Madwort or Yellow Alyssum, Rock Rose and Rock Cress, Cistus, Spanish and Moonlight Broom, Scotch Heather and Irish Heath, some of the Rockfoils and Alpine Pinks, while shady nooks and crannies rely for their blossom largely on Alpine Primroses and Orchids, Wood Lilies, Wood Anemones, the Pyrenean Ramondia, Ferns in great variety, King Cups and Alpine Buttercups, and the Balearic Sandwort, that spreads a veil of green over barren rocks, and in summer hides both beneath countless tiny blossoms of purest white. When such as these are in bloom the rock garden is in its fullest beauty, its most enchanting mood, and gives the greatest joy to the majority of flower lovers. But the rock garden has also another phase of beauty that appeals no less successfully, though less ostentatiously, to those who understand its ways. For there comes a time when the brilliant masses of blossom, surpassingly beautiful though they may be, fail to satisfy the longings of the enthusiast. He turns for perfect enjoyment to individual plants, to those that give less prodigally of their bloom, and blossom only when experience has taught exactly how they should be grown.

Wall gardening may be described as at once one of the oldest and one of the newest ways of growing flowers. Are there not wall gardens sown by Nature herself centuries ago, walls whose stones are hidden beneath moss and lichen, whose every chink and crack is filled with Fern or other wilding? Yes, Nature's wall gardens are beautifully old, yet it is only within recent years that growing flowers in walls has become one of the fashionable ways of gardening. Now, in many gardens one sees specially made "dry" walls, built against banks of soil, without cement and without mortar, and, in due time, draped with masses of fairest flowers. Spaces are left between the stones, seeds or tiny plants are planted in the chinks, and soon their roots search deep in the soil behind.

To make a real wall garden one must begin early, for it is only beautiful when it has grown old. This is true of all gardens, but it is especially true of the wall garden. The greatest charm clings to the wall gardens that are old—old only in flight of years—those draped with lovely carelessness by ivy masses, whose crumbling walls are pierced by Ferns and topped by stunted Wallflowers, by casual bird-sown rowan or bramble, by beautiful wind-sown weeds. The artificial wall garden can scarcely ever hope to possess that *abandon*, that charm of perfect naturalness by which the wild wall gardens are distinguished. Still, if the seeds and plants are left to grow just how and where they please, passing years serve but to increase the beauty of the garden in the wall. Planted at the top of the wall where there is good depth of soil, there should be masses of purple and white Arabis, of evergreen Candytuft, throwing a light drapery of leaf and blossom across the rocky face and in the chinks and crevices, Wallflowers, Rockfoils, particularly the queen of all Saxifrages, the Pyramidal Rockfoil, Ferns self-sown, Snapdragons, Alpine Pink and Catchfly, patches of Heather, and the Ramondia that plants its broad leaves flat against the face of the wall and crowns these with blue and yellow blossoms. The wall of flowers is essentially a garden where the fittest are allowed to survive, and the tending is left to Nature.

Water gardens vary greatly in size, in aspect and in situation, but these things matter little if a sense of peace is all-pervading. A sense of repose should be inseparably associated with the water garden, so that at high noon in full summer time one may turn from gaudy flower-filled beds and borders for restful thoughts and subtle daylight dreams, that, for the moment, throw a veil over the world of

Photograph by F. Mason Good, Winchfield.

THE WATER GARDEN, MILTON COURT, DORKING.

hurry and bustle and strife, leaving one alone with that most refreshing of all Nature's sights and sounds—running, rippling water. Whether large or small, the surface should be flecked with floating Nymphaeas, in crimson, pink and white, with the wild yellow Nuphar, the flowering Rush, Bog Bean and Crowfoot, that make such perfect water gardens of roadside ponds and meadow pools. Here and there the cool white spathes and glossy leaves of the African Swamp Lily, Arum or Calla, give picturesqueness to the water surface, while the muddy edges of the shore are a mass of flower-fringed beauty. Here, gathered from among our own wild blooms and those of exotic lands, one should find the Yellow Flag, the graceful blue of the Siberian Iris, purple Loosestrife and rosy Willow-herb, the tall Yellow Lysimachia (of Creeping Jenny family), the common Toadflax and grey-leaved Potentil that spangle the banks of English rivers, giant grasses with graceful plumes. Close by, with their roots in drier ground, are planted Foxgloves, Pampas Grass, Spiraea or Meadow Sweet in red and cream and white, Brambles for flower and fruit, Japanese Roses, that bear large single blooms in early summer, and brilliant fruits when the blackberries ripen. These and other wild and stately plants should be disposed about the water garden, blending the latter harmoniously with the garden landscape and half concealing it. The water garden loses half its charm if it is seen from a distance. The glamour of the garden lies in the hidden, unsuspected beauties that show at every turn.

H. H. THOMAS.

Photograph by F. Mason Good, Winchfield.

THE ROCK GARDEN, SHENFIELD MANOR, NEAR BASINGSTOKE.

"THE RESTLESS SEA."
From the Water-Colour Drawing by W. L. Wyllie, R.A.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.
With Photographs by HENRY IRVING

THE MEADOW FLOWERS

THE BUTTERCUPS

FIRST and foremost among the meadow flowers must be placed the Buttercups, and of those there are four different kinds, which can be easily distinguished from each other. The Bulbous Buttercup (*Ranunculus bulbosus*) is so called because the stem is usually thickened at the base into a sort of bulb; the flower stalks are furrowed and hairy, while the green sepals at the back of the yellow petals bend backwards towards the stalk when the flower expands. The Hairy Buttercup (*Ranunculus hirsutus*) also has the sepals of the expanded flower bent back, but the roots are fibres, and there is no trace of a bulbous thickening.

The Creeping Buttercup (*Ranunculus repens*), as the name implies, sends out runners in the same way as the Strawberry does, from among the lower leaves, which take root very rapidly and form fresh plants. Neither in this species nor in the Common Buttercup (*Ranunculus acris*) do the sepals bend back towards the flower stalk, but the creeping habit of the former will readily distinguish it from the latter.

The Common Buttercup is generally one of the tallest of the race, sometimes

THE CREEPING BUTTERCUP.

reaching a height of three feet; it begins to flower early in the summer and continues till late in the autumn. Each petal will be found to have a small yellow scale at the base, and the leaves are much cut

GERMANDER SPEEDWELL.

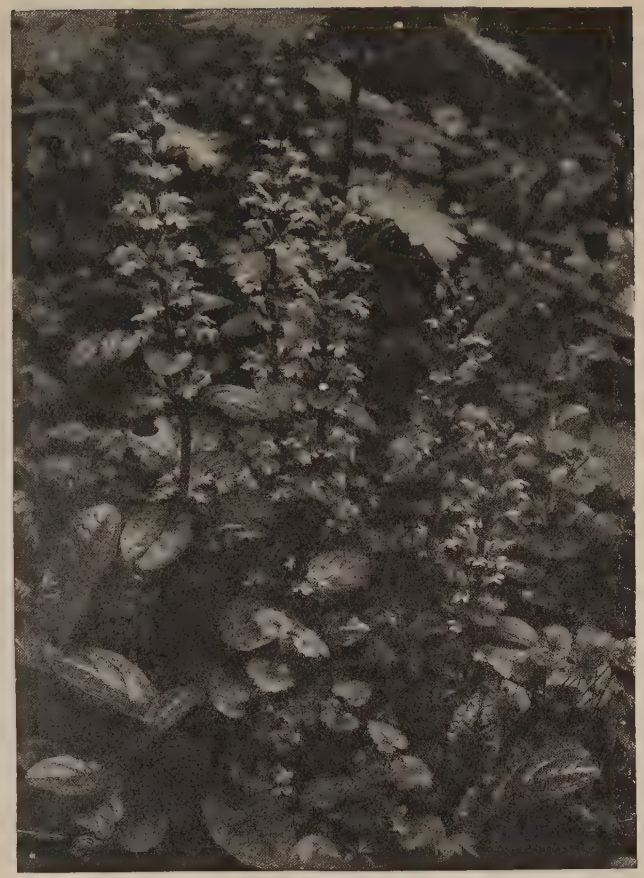
into segments, but the general form of the leaf is a rounded one, and the flowering stems are quite smooth, not furrowed as in the Creeping Buttercup. This plant is the Crowfoot that is so hated by dairy farmers; its juice is very acrid and is said to produce blisters, which may account for the cattle disliking it so much. It is found in very large numbers growing in pastures, and it is very difficult to eradicate. The Buttercups are visited by a great many different kinds of insects, which, attracted by the bright, golden blossoms, come to search for the honey secreted at the base of the petals; the pollen from the ripe anthers dust their abdomens, and in this manner it is conveyed from flower to flower. If a bud of the Common Buttercup be examined, it will be seen that insect visitors are kept from intruding and stealing the honey before the stamens are ripe by a fringe of hairs on the calyx. In wet weather the pollen is protected from the rain by the closing of the blossom and the curling of the stem; this latter making the flower hang with its head downwards.

BUGLE

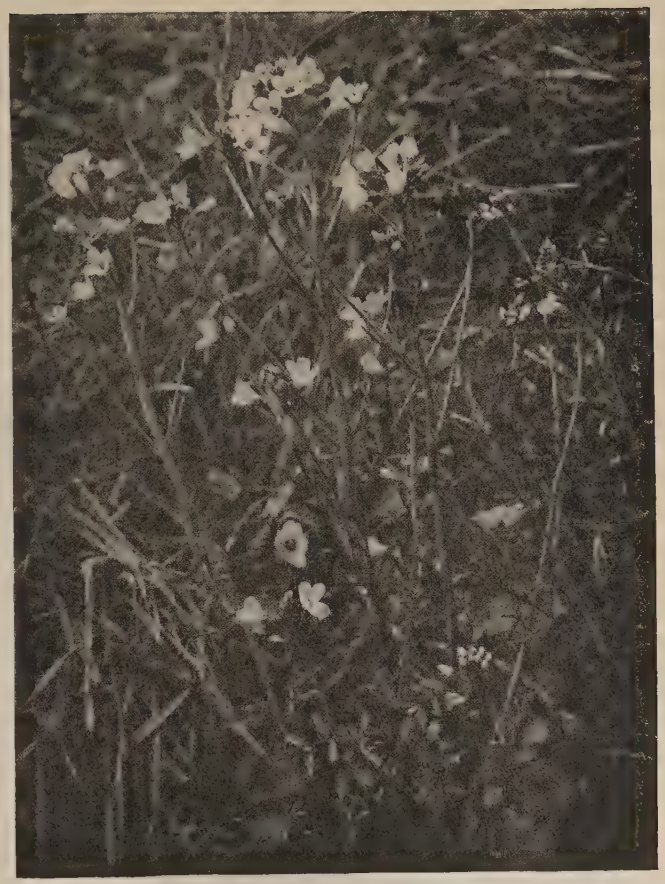
A plant which is often to be found in pastures, but which grows also in moist woods and hedgerows, is the Bugle (*Ajuga reptans*). The two-lipped corolla will at once place it among the *Labiatæ*, in the same family as the Dead-Nettles, Wood-Sage and Ground Ivy; the upper lip, however, is very small, but the flower is more or less protected from the wet by being placed under the leafy bract of the flower just above it. The whole plant grows from three to twelve inches high, according to its position; it is almost free from hairs; the leaves are quite simple and arranged in pairs, as is the case with all the members of this big family. The rootstock creeps along, sending forth here and there an erect flowering stem; the flowers are borne in clusters round the stem (*i.e.*, in a whorl), in the axils of the leaves—the general colour is blue, but sometimes they may be found pink or white. The plant is in blossom from early in April to the end of June, and thrives best in damp spots. The name Bugle is said to come from a Latin word referring to a small glass pipe, which was used in feminine head-gear in the Middle Ages, and which the blossoms of this plant more or less resemble.

SPEEDWELL

Several sorts of Speedwell, or Bird's Eye, will be found growing by the wayside, in pastures, and in all kinds of waste

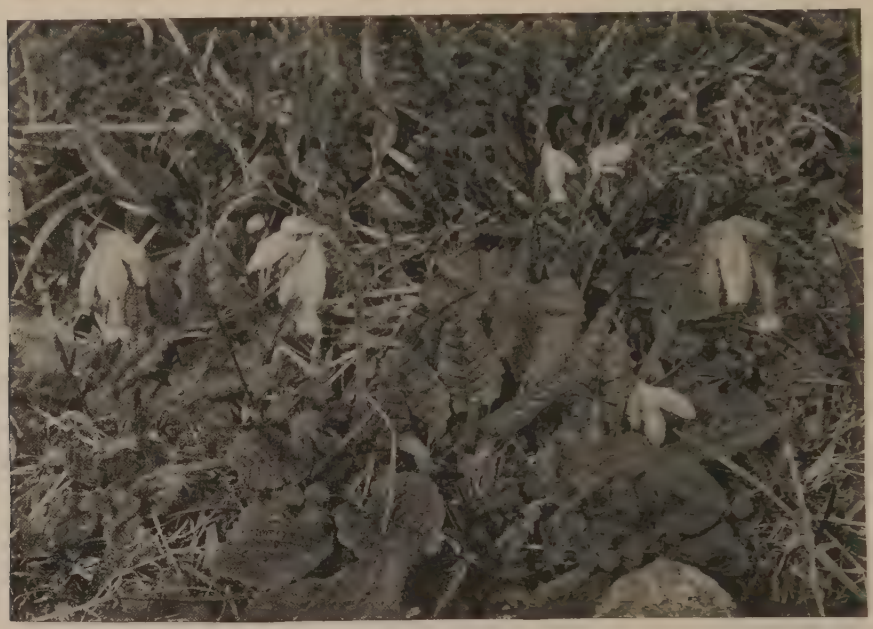


BUGLE.



CUCKOO FLOWER (LADY'S SMOCK).

places; the one shown in the photograph is the Germander Speedwell (*Veronica Chamædrys*), which flowers during May and June, and possibly for a little longer. These plants will be readily recognised by the bright blue flowers which tumble off under almost any pretext. The stamens



THE COWSLIP.

of this genus are reduced in number to two (the majority of the family of *Scrophularineæ* have four), and project somewhat. They are visited largely by the yellow-banded Hover-flies, which hover over a flower and then dart off like lightning to another spot. Probably the stamens act as a support to the body of the fly as it hovers and sucks up the honey; the pollen will naturally cling to the abdomen, and be transferred to the stigma of another flower which sticks out in a straight position; any larger number of stamens would only be in the way. The name Veronica is of doubtful origin; possibly these plants were named after St. Veronica, a saint of the Romish Church. Bird's Eye comes from the bright blue colour, and Speedwell from the flighty disposition of the blossoms. Tournefort's Speedwell, a trailing plant with large blue flowers, is a common weed, but it is not really a native.

CUCKOO FLOWER

The Lady's Smock, or Cuckoo Flower (*Cardamine pratensis*), as the old herbalist Gerarde says, "flowers in April and May, when the Cuckowe doth begin to sing her pleasant notes without stammering." The first name is due to the likeness borne by the pendulous white flowers to little smocks hung out to dry, as they used to be at this time of the year for bleaching purposes; Bittercress is also another name for it. The four white, or very often pale lilac, petals arranged in the form of a cross (as in all the *Cruciferæ*) and the pinnate leaves will be sufficient guides for recognition; in damp meadows and by the sides of streams it is found very abundantly during spring and early summer. The leaves, although a little bitter, may be used and eaten as cress; the fruit is a long pod.

THE COWSLIP

Throughout May and June many of the pastures will produce quantities of Cowslips (*Primula veris*). It is a very near relation of the Primrose, and the same pin-eyed and thrum-eyed arrangement of the stamens and pistil will be found. The calyx is of a pale green colour, the

corolla being deep yellow; the scent is very delicate; the flowers are borne on short stalks, all starting from the same point on the summit of the main flower-stem. We very frequently may find varieties of the Primrose which have several flowers on the same stem; the Oxlip and Polyanthus are examples, but in both of these the flowers are very much larger than those of the Cowslip. In the eastern counties the common name for the plant is Paigle; the word is spelt in many different ways, and its derivation and meaning are quite obscure. Another name for it is Herb Peter, from the resemblance of the head of flowers to a bunch of keys, the badge of St. Peter. In olden times it was used as a cure for paralysis, and was named Palsy-wort (*Herba paralyseos*). Cowslip wine is still made, the large secretion of honey in the tube of the corolla imparting a very sweet taste to the decoction.

BLADDER CAMPION.

BLADDER CAMPION

The Bladder Campion (*Silene cucubalus*) is frequently to be found throughout the summer, but it cannot be called a very common plant. It owes its name to its peculiar, inflated calyx, which is more than half an inch long and lined with many veins; after flowering the bladder grows more globular in shape. The petals are five in number, each one being somewhat deeply cleft, and having a small scale at the base, as is common to the members of the Pink family (*Caryophyllaceæ*). If several of the flowers be examined it will be found that these are of three kinds, some where only the ten stamens are perfect, some where the pistils only are perfect, and others which have both sets of organs complete. The Bladder Campion will be found growing in meadows and on roadside wastes and also at the edges of cornfields; it is a near relation to the White Campion or Bachelor's Buttons (*Lychnis alba*), to the Red Lychnis (*Lychnis diurna*), and to the Ragged Robin (*Lychnis Floscuculi*).

DANDELION

The Dandelion (*Taraxacum officinale*) blooms continuously from February till well on into October. Like the Daisy, it is one of the Composite family, but all the small single flowers are strap-shaped; each one bears both stamens and stigmas, the fruit, when ripe, having a feathery pappus, so that any slight breeze is sufficient to blow it away and so to assist in the dispersal of the seed. All the leaves and flower

DANDELION.

DEVIL'S-BIT SCABIOUS.

stems spring up from the root ; the stems contain a pungent, milky juice, and those bearing the flower heads are hollow. As to the origin of the name Dandelion, or Lion's Tooth, there are various opinions, but the most probable one is that it was given from the jagged tooth-like lobes of the leaf, albeit these resemble rather the jaw than the tooth of a lion.

DEVIL'S-BIT SCABIOUS

Many pastures during August and September from a distance appear to be tinged with deep blue, and this will most likely be due to the Devil's-bit Scabious (*Scabiosa Succisa*), a plant which is very fond of open meadow-land. A close relation, *Scabiosa arvensis*, is to be seen frequently in the hedgerows and woods, with much larger heads of flowers, of a pale lilac colour. Like the Dandelion, it bears a head of small florets, although it is not included in the Composite family, because each floret appears to have a calyx to itself : this is the distinguishing mark between the Compositæ and the Teasel family. If one of the root-stocks be dug up, it will be seen—if the plant be a young one—to be somewhat after the shape of a carrot, but if it is over a year old it will be more woody, and terminate abruptly as if the end had been bitten off. The legend runs that the root was a cure for all diseases, and "the Devill, for the envie that he beareth to mankind, bit it off at the root, because else it would be good for many uses." The leaves are hairy and rough, and spring mostly from the rootstock ; a few small leaves, generally with one or two teeth, are to be found on the stems.

PINK CENTAURY

In July the Pink Centaury (*Centaurium umbellatum*) begins to put forth its showy flowers. This is one of the Gentian family, and delights in dry pastures and sandy places. The leaves growing on the stem are stalkless and arranged in pairs, those lower down forming a tuft ; each leaf has three distinct veins on the upper surface. A cluster of pink, or red, or sometimes white flowers is borne on the summit of each stem ; the corolla (or combined petals) has a slender tube fitting on to the calyx, and has five spreading divisions, star-like in shape. There are five stamens, and the anthers twist spirally after the pollen has been shed. The plant varies very much in its way of growth, but generally it is about eight inches high ; the blooms close about three o'clock in the afternoon, and also when the sky is overcast or when there is much moisture in the atmosphere.

CENTAURY.

H. Purefoy FitzGerald.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

THE TROUT

NO fish that is born in fresh water arouses so keen an interest as the Trout. It is the theme of poets, the subject of many learned treatises, and the fish most beloved by the craft of anglers. The very name of the Trout brings recollections and visions of delightful mountain burns, rushing down from the scented peat bogs, in little gorges fringed with heather and fern ; of rippled lochs, shining beneath the crags, and of quiet meadow country, where the fields are bright with patches of the kingcup, and the river flows sedately by trim farms, and through the arches of ancient grey bridges.

For the Trout is a creature of many waters, haunting the deep weir-pools of the Thames, the unfathomed pools of the mountains, the stripling streams of the moors, and the gliding rivers of the lowlands. Its habits, too, are elusive and fascinating ; they afford an unending subject of discussion among those who follow the gentle art of fly-fishing and live much by the waterside. No man has ever learned all that can be learned concerning the reproduction of Trout, the conditions that govern their rapid growth in certain rivers, their adaptation to the waters in which they are bred, their instinct for wandering and exploring, and their cunning in outwitting the enemies that prey upon them. Even the gold and scarlet markings of the scales of a Trout open a wide field of scientific investigation into the wonders of natural selection ; for there is little doubt that the handsome burnished Trout of clear streams, with its bright spots and innumerable speckles, has been evolved from the silvery Trout of the sea, that near relative of the Salmon.

To know something of the life-history of the Brown Trout, we must watch the waters with the keen vision of the heron or the kingfisher, and track the little fry in the tributaries that serve as nurseries to the main stream. We must visit the tarns that are hidden among the hummocks of the uplands, gaze into the deep, green pools of the rivers, and observe the fish when they are feeding, pairing, and migrating in the autumn. The study of fishes is, in many respects, more difficult than that of quadrupeds and birds ; for the waters often baffle us, and the fish are very cautious in concealing themselves.

Trout are alert and nervous, and ages of adventure in evading the pursuit of the otter, and the several species of aquatic birds that feed upon them—not to speak of the experience gained during the centuries of fly-fishing—have taught them that concealment is an essential of their existence. This is why the casual rambler by the banks of a Trout stream may spend hours without seeing a single fish. He may, indeed, reach the conclusion that there are no Trout in the river. But the fisherman, whose eye is quick for those dimples that mark the spot where a Trout is rising to flies on the surface, knows that there are as many good Trout in the stream as ever came out of it.

The first scene in the life of a Trout is enacted at that hour when he emerges from the egg or spawn globule, which has been deposited by the parent on a clean bed of gravel. The " redds " or spawning grounds are selected with great care,

and they are usually situated in the affluents of the main river. From the time that the ova are deposited until the young Trout are big enough to take care of themselves, the spawn and the immature fish are exposed to many risks of destruction. A heavy flood sometimes causes the washing of silt and mud on to the spawning beds, and the eggs are lost.

A NURSERY OF TROUT.

Then there are the depredations of fish and birds. Eels are voracious devourers of ova, and even Trout will eat the spawn of their own species. Various aquatic birds, and domestic swans, geese and ducks, if they have access to the stream, consume a quantity of the eggs.

The diminutive Trout that emerges from the ovum is called an alevin. These tiny fry swim in dense shoals, and are to be seen in the quiet eddies and bays of the river, while they often swarm in the runnels. Their rate of growth is usually rapid, and they disperse before they are a few months old, and haunt the feeding-places of the mature Trout. Their chief enemies now are the heron, kingfisher, and the gull—among birds; and among fish the larger Trout are often their worst foes. Most Trout of half a pound, and even of less weight, will seize and swallow their smaller neighbours. More serious still are the attacks of pike and chub, which often breed in the lower reaches of Trout rivers. The otter also takes his toll of Trout; but he is not so destructive as many anglers imagine, for he subsists principally upon eels, frogs, and black slugs.

As the Trout approach the yearling stage, they become adventurous, and love to explore the streams. They frequent the shallows as soon as the temperature of the water rises in spring; and at this season they rise most eagerly to the flies that float upon the surface. A diet of surface insects restores them to good condition after the process of spawning; they become brighter in the scales, and their flesh is firmer after a few weeks of liberal feeding upon flies. Water that contains ample food produces big Trout in a short time; while in streams or lakes where bottom and surface food is scarce, Trout are small and often attenuated. The fresh-water shrimp, water snails, and minnows are highly nourishing. Besides these, the river beds supply the larvæ of flies and beetles; and in flood time worms and land insects are washed into the rivers.

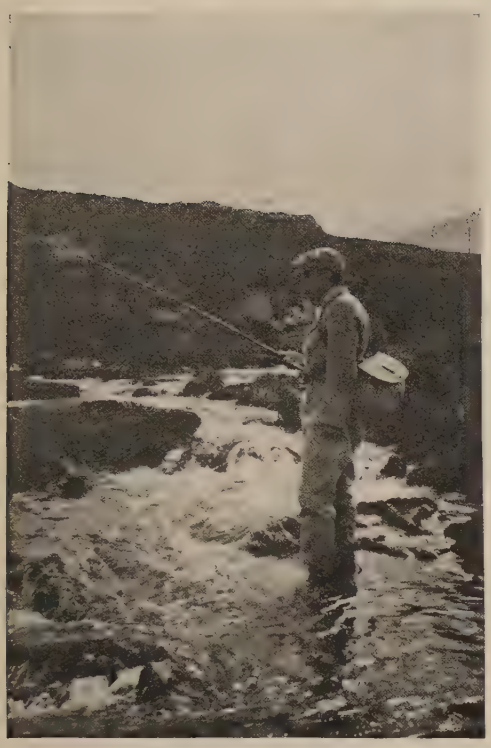
A Trout of five years old may weigh over three pounds, or it may weigh no more than three ounces. Everything depends upon the quantity and quality of the food supply. Yearling Trout, reared in hatcheries and stock ponds, and turned into waters abundantly provided with insect life, very quickly grow into goodly fish. Blagdon Lake, near Bristol, is a water that presents every natural advantage for the production of heavy Trout; and small Trout, introduced to this lake, have grown almost miraculously in a short period.

What a difference is presented by the unshapely, dwarfed Trout of a cold Welsh lake among the mountains, or one of the over-populated lochs of the Highlands of Scotland, and the handsome, well-fed Trout of Blagdon. In Llyn Howel, for example—a deep pool in a rocky basin of the Harlech Mountains—the Trout are veritable pigmies, with large heads and big, staring eyes. No doubt many of these starved fish are several years old. The Lake District offers similar instances of stunted Trout in elevated tarns, though the lakes in a lower altitude produce Trout of two pounds and upwards.

The rivers that favour the vigorous growth of Trout are usually those which water a fairly fertile region of pasture and cultivated land. A belt of trees by the stream, the presence of weed in the water, and reeds along the banks, tend to the increase of weight in Trout. Wherever a few trees and bushes clothe the bank of an upland brook, the Trout are larger than those that frequent the bare reaches. Every tree produces and harbours insects, which often fall upon the surface of the stream or fly close to the water, and provide food for the Trout that lurk in the shadow of the boughs.

A SOUTH-COUNTRY TROUT STREAM.

In such streams as the Chess and the Ivel, in Bucks, and the Test and Itchen, in Hants, the Trout are large, plump in appearance, and beautifully coloured. But if we entice the Trout of a Dartmoor brook with an artificial fly, we shall find that their average weight is under a quarter of a pound, and that they are darker and less golden than those of more generous streams. More marked still is the difference that we shall find in the almost black Troutlets that swim in the dark, peaty waters of a boggy fell



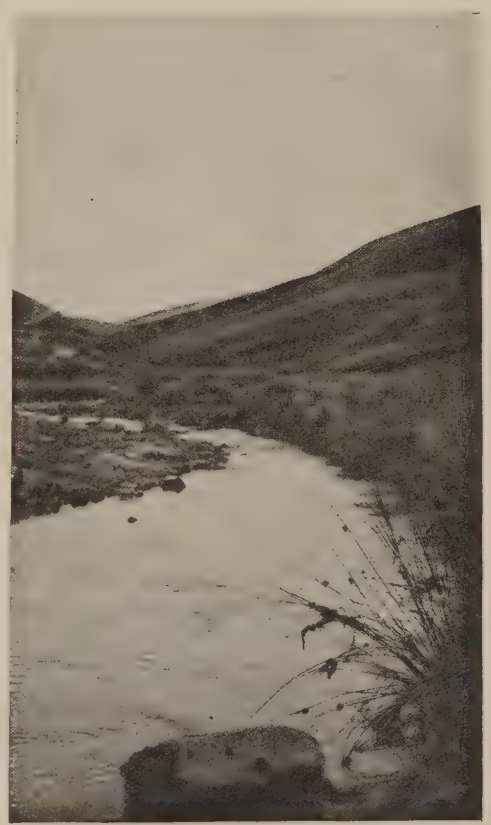
A MOUNTAIN STREAM.

in Cumberland, or in some mountain rivulets of Wales and Ireland.

One of Nature's means of protection for all animals, including fish, is the adaptation of their colour to the surroundings of their habitat. In some rivers there is a very distinct difference in the shade and spots of the Trout that frequent particular reaches. Where the river has a sandy, golden bed, the Trout are light in hue. In the deep pools of green water, the fish have a greenish tint on the back ; while in the peat-stained lengths of the higher waters the Trout are dark. This adaptation is so cunning that only the well-trained eye of the fisherman can detect the Trout amid their surroundings, and even the most observant of anglers fails to see scores of the fish on a clear, rippling shallow.

The instinct of concealment is very strong in Trout, and their cautiousness increases with their age. It is a mystery where big Trout hide themselves when a river is low after a long spell of drought. Not a fish can be seen from six in the morning until after twilight in those hundred yards of the stream. Yet at night this length will be ringed from end to end by rising Trout. During low water periods, many Trout travel to the deeper pools of the rivers, and those that remain in the shallows discover unsuspected hiding-places. They lie beneath big stones, in patches of weeds, and under the projecting ledges of the banks, or refuse to leave the broken waters of "runs," where their detection by the eye of enemies is difficult.

When a downpour of rain brings stained water into the stream, Trout are less wary and suspicious. The prospect of liberal fare brings them out of their lurking-places, and they distribute themselves in most parts of the river. If the spate, or flood, is high and the stream much swollen, Trout resort to the long pools, and congregate in the bays and



A RIVER POOL.

eddies out of the fierce rush of the water.

Long combat for existence has educated the Trout of our rivers to a remarkable degree. There are streams that the angler calls "difficult," such as the crystal Dove, or the Darenth in Kent, wherein the Trout are so experienced in self-protection that even the most capable fisherman finds his skill severely taxed in competition with his wily prey. To tempt these shrewd Trout, the fly-fisher uses the most delicate of tackle and flies that are works of art. An unfamiliar shadow on the water, a dubious disturbance of the surface, no matter how slight, and the flash of a rod in the air, will scare these sophisticated fish into the deeps. Again and again they will refuse the most tempting counterfeit of a natural insect, presented with the rarest adroitness.

Photograph by Wilson, Aberdeen.
A FALL ASCENDED BY TROUT.
Leny Falls, Perthshire.

Very different, though not without cunning, are the Trout of remote lochs and unfrequented rivers. They have a less wide experience of the race of anglers, and the poverty of their food supply often makes them unwary. These are the Trout that rejoice the novice in fly-fishing, for their capture requires less skill than that demanded by their brethren of the much-fished waters.

October is a month of much importance in the life of the Trout. It is the period when the passion for wandering seizes the fish, and the one supreme object is that of migration to the spawning beds. If the tributaries are low, this is the time when the poacher reaps his plunder, for Trout, heavy with spawn, or bent upon pairing, are apt to expose themselves to danger in the shallow reaches of rivulets. In the surmounting of the falls of streams at this season Trout show a marvellous strength and pertinacity. I have seen a Trout, no longer than my forefinger, working its way from ledge to ledge of a tumbling cascade of fifteen feet in height, an obstacle that no salmon would venture to ascend. The abundance of Troutlets in the highest pools of mountain burns, above high falls, proves beyond question that these fish are possessed with a passionate love of exploring, and a wonderful capacity for mounting waterfalls.

WALTER M. GALLICHAN.

A TROUT LOCH.

THE CLIFFS AND THEIR STORY—I

By F. MARTIN DUNCAN, F.R.P.S.

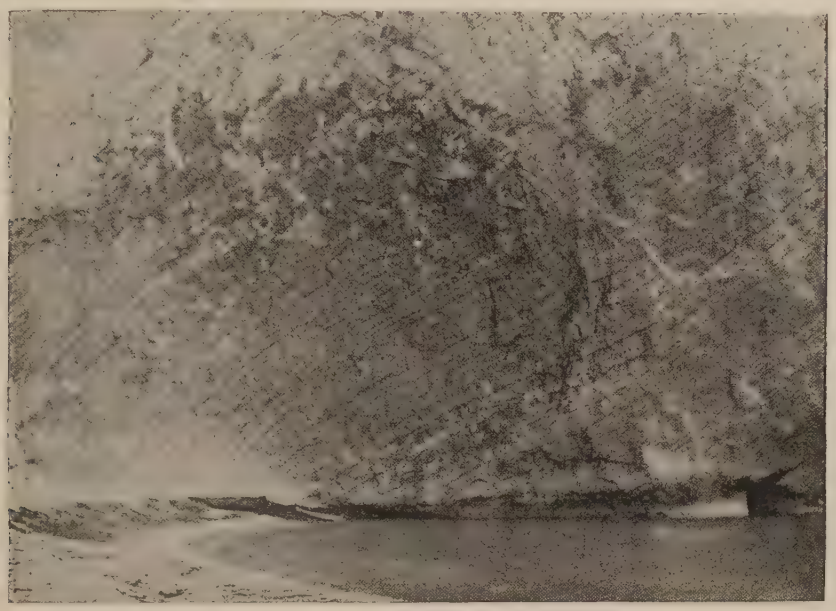
With Photographs by the Author

THE white cliffs of old England! What a thrill of eager longing and pleasure that simple sentence brings to the hearts of those who are homeward-bound, after long absence in strange lands; and how eagerly are all eyes strained to catch the first glimpse of the fair white walls—Nature's ramparts—that guard our island home! Could they speak, those same white cliffs that tower above us so majestically, what wonderful stories could they relate of the changes that have passed across the face of the earth since they were called into being! But, although the cliffs cannot speak to us with articulate words, we can learn much of their past history by a little careful examination of their shape and composition.

"THE WHITE CLIFFS OF OLD ENGLAND."

With the aid of a geological map of England, we can trace the chalk underlying all that part of England situated to the south-east of an imaginary line drawn diagonally from the Dorset coast to Flamborough Head, though it is not visible at the surface all the way, but lies hidden beneath deposits of sands and clays. The southern edge of this great area of chalk formation has been crushed and distorted upwards by some great earth-movement of the past in a most remarkable manner, so that in the cliffs of the Isle of Wight and Dorset the chalk is to be seen standing perpendicularly on edge. A most delightful and interesting experience is to take a boat on a still, early summer morning, at Freshwater, Isle of Wight, and to let the boatman row you towards the Needles, keeping the boat fairly close in under the cliffs. Shortly after putting out from the shore, the scene becomes singularly impressive, the great white cliffs towering up many hundred feet into the deep blue of the summer sky. Save for the splash of the oars, and the quiet, mysterious

whisperings of the waves as they wash against the great rocks at the base of the cliffs, not a sound is to be heard. It is as if Nature herself paid silent homage to these majestic monuments of the dead past. Suddenly the solemn hush is broken



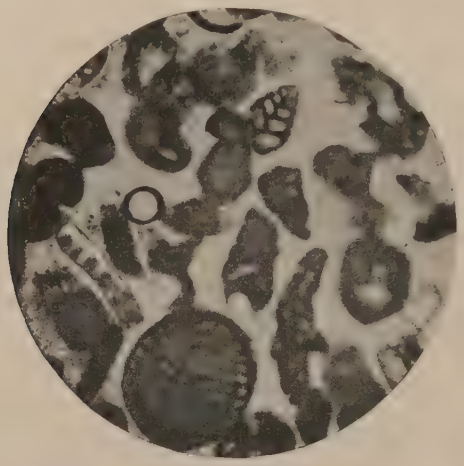
"A NARROW BAY THAT FACES THE NEEDLES."

by peals of uncanny laughter and shrill calls from the ledges on the vertical face of the cliffs. It is the laughter of the nesting gulls, disturbed at our approach. Numbers swoop and circle over our heads, uttering their shrill, plaintive cries. A narrow bay that faces the Needles affords delightful facilities to study our subject. The shore is practically composed of shingles, and on all sides there is ample evidence of the action of the waves upon the base of the cliffs, which helps us to realise how the Needles have become separated from the island by the combined action of the atmosphere and the waves. Should there have been a recent fall of *débris* from the face of the cliff we shall probably be able to collect from amongst the freshly-exposed masses some of the fossils peculiar to the chalk formation.

Now let us see if we can find out of what materials the chalk cliffs are composed, and how they came to be formed. To do this, we must call in the aid of the microscope, so that we may examine the minute structure of the cliffs. If we make a very, very thin section, or slice, of a piece of this chalk broken away from the cliff, and place it under the microscope, we shall see that it is very largely composed of countless minute bodies, more or less symmetrical in shape, each built up of a number of globular chambers, arranged in a series. Scattered amongst these prevailing globular bodies are other minute shells, some resembling tiny replicas of the beautiful Nautilus shells to be seen in our natural history museums, together with sponge-spicules, etc.; and all are embedded in a fine white dust composed of carbonate of lime.

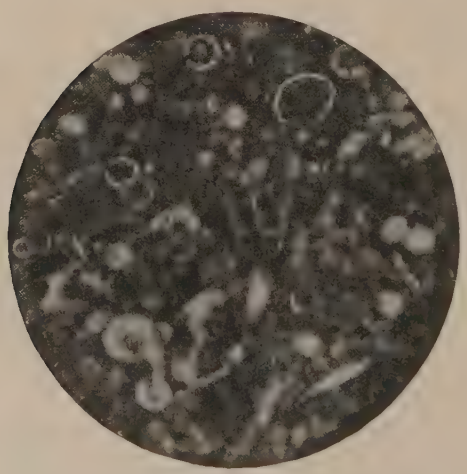
For many years the chalk cliffs were a bone of contention and a great puzzle amongst geologists, who were engaged in striving to piece together the evidence which should show how this vast area of chalk had been formed in the past. One great question was how to reconcile the fact that chalk is almost identical in its chemical composition with ordinary limestone, with the conflicting fact that it is of an absolutely distinct internal struc-

ture. Then there was also the question of the preponderance of the oval-chambered bodies in the chalk, and the invariable absence of those organic remains



A SECTION OF CHALK, SHOWING FOSSIL REMAINS OF *FORAMINIFERA* AND SPONGE SPICULES.

which are always prevalent in ordinary limestone; and why flint, which is so rare in ordinary limestone, should be so abundant in the chalk. The fossil remains of sea-urchins, marine shells, corals, fishes, etc., all proved that the chalk, like the

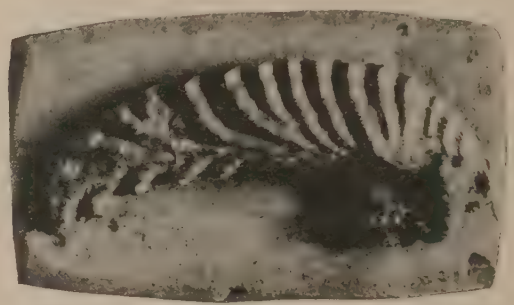


A THIN SECTION OF CHALK IS SEEN TO BE CHIEFLY COMPOSED OF THE SHELLS OF GLOBIGERINÆ.

majority of the limestones, must have been formed beneath the surface of the sea, without, however, accounting for the characteristic differences of the two formations.

It has been one of the triumphs of biology that it has solved these puzzling questions, and clearly demonstrated how the chalk has been formed; and it is to the able and untiring investigations of the late Professor Huxley, Dr. Wallich, and Dr. Ehrenberg that the problems of the chalk formation have been solved.

Prior to the laying down of the first telegraph cable between Ireland and Newfoundland, a survey was made of that part of the bed of the sea upon which the cable was to rest; and the samples of mud dredged up during this survey were sent for microscopic examination to Professor Huxley and Dr. Ehrenberg. The mud obtained by the survey expedition was generally a whitish-grey in colour, and

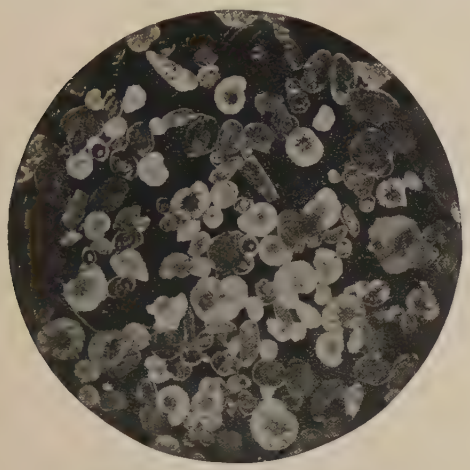


OSTREA CARINATA: A FOSSIL OYSTER FOUND IN THE CHALK CLIFFS AT DOVER.

because of its peculiar characteristic appearance received the name of "ooze." When some of this ooze was examined under the microscope, it was at once seen to be largely composed of the same globular bodies that are such an important characteristic of the chalk—the shells of a most interesting minute creature called, from its globular shape, the Globigerina. So, on account of the predominance of these globular shells in the mud, it has been called the "Globigerina ooze."

The result of these deep-sea dredgings and their microscopical examination was to demonstrate that over a great part of the bed of the North Atlantic a very wonderful deposit of the Globigerina ooze is being formed. This consists almost entirely of an aggregation of the microscopic shells of the Globigerina, a creature belonging to a wonderful

and beautiful group of tiny organisms called the *Foraminifera* — microscopic creatures with perforated shells. The tiny Globigerina spends the greater part, if not the whole, of its life on the



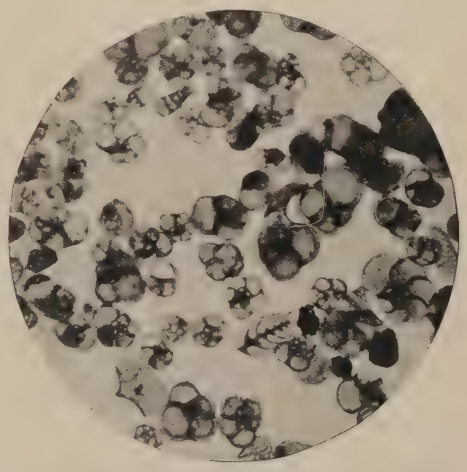
FORAMINIFERA FROM THE SURFACE OF THE SEA.
Note how closely they resemble the fossil forms found in chalk.

surface of the sea, where it forms its minute shell, which only measures between $\frac{1}{20}$th and $\frac{1}{30}$th of an inch in diameter, out of the carbonate of lime which the little creature extracts from the sea-water, and from the organisms upon which it feeds. This shell is composed of several globe-shaped chambers, the walls of which are pierced by numerous minute holes, through which the creature protrudes a network of delicate protoplasmic threads, by means of which it captures its food.

When they die, the Globigerinæ slowly sink to the bottom of the sea in countless numbers, where they accumulate and form about 85 per cent. of the ooze. In this way a constant rain of millions upon millions of these shells is for ever falling from the surface waters to the floor of the Atlantic Ocean, where they are slowly building up a chalk formation which is identical in general character with the chalk cliffs of England, and which in the fulness of time will rise, or be thrust by some great submarine upheaval, above the surface of the sea to form, perhaps, a new Albion or Atlantis.

Such, in brief, is the story of the white chalk cliffs of England. In the dim geological past they were formed beneath the surface of an ancient sea that covered the Western half of the Old World from Britain to the Hindoo Koosh. Gradually, through the passage of the centuries, they have been raised above the sea and have assumed the form and appearance with which we are so familiar.

Solid and majestic as they look, Nature is at work upon the cliffs with her keen tools—the rain, the winds, the frost, and the waves—slowly but surely smoothing and wearing them away. Those portions which fall into the sea are crushed into the finest particles and carried away by ocean currents to be absorbed by and built up into the shells of the *Foraminifera*, the rest to sink slowly, along with those minute shells of the Globigerinæ, to the floor of the ocean, to help in the formation of the chalk cliffs of a future land. Truly, as we examine those towering, majestic chalk cliffs, and realise how Nature is for ever at work upon them, changing, though ever so gradually perhaps, their shape, the beauty of Tennyson's lines, and their perfect description of what is for ever taking place, is vividly brought before us—



OOZE FROM THE BOTTOM OF THE NORTH ATLANTIC.
It is composed almost entirely of Globigerina shells.

"The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds they shape themselves and go."

F. MARTIN DUNCAN.

THE SLEEP OF PLANTS

By S. LEONARD BASTIN

With Photographs by the Author

AS the sun sinks towards the western horizon a very great change comes over the countryside. Already the birds and insects which were so busy at high noon begin to feel the approach of the night, and turn their attentions to the question of where they may safely spend the hours of darkness. Amongst the plants, too, the failing light in the late afternoon is the signal for a great preparation, without which the well-being of vegetation would be seriously endangered. The great Linnæus, walking in the fields and gardens at dusk, saw that a very obvious alteration had taken place in the bearing of many plants. The foliage seemed as if it were gathered together, whilst many a flower head, which had been erect and open in the sunshine, was now drooping with closed petals. It scarcely seems that the naturalist really grasped the true meaning of the phenomenon which he noticed, although his was certainly a pleasing fancy that designated this evening change as the "sleep of plants." Modern research has done a good deal, it is to be feared, to dispel this romantic idea, for we now know that plants do not sleep in the sense of the word as applied to the taking of rest.

DAY POSITION OF CLOVER.

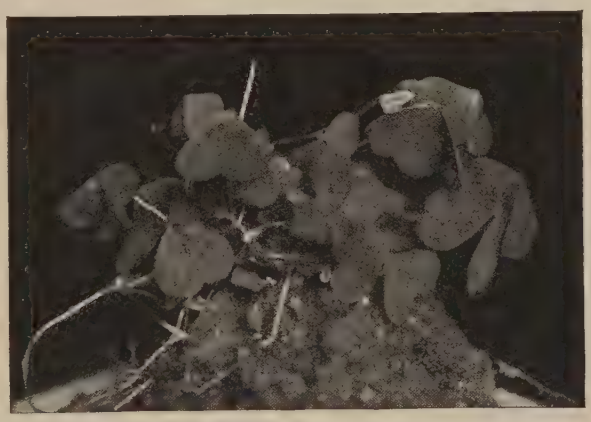
NIGHT POSITION OF CLOVER.

Indeed, at the time when the plant is in its most active state of growth, certain processes, such as the elongation of stalk, for instance, take place more vigorously in the darkness than during the day-time.

WOOD SORREL: DAY POSITION.

Despite the fact that we cannot say that plants commence a period of repose with the coming of evening, the state upon which they enter at this time will almost justify us in saying that they go to sleep. We must remember that it is only during the hours of bright daylight that the elaboration of the wonderful chlorophyll—the vital green part of the plant—can take place. It is likely, also, that the sap movements are much less vigorous at night than when the exhalation of moisture is being stimulated by the action of the hot sun on the leaves. Moreover, as with the animal, so it is with the plant, the night is a time of danger; two great enemies will be abroad—cold and damp—and it is to guard against the damage arising from these conditions that all the precautions of the plant are taken. To restrain a plant in such a way that its flowers and foliage are kept expanded throughout the night, is in many cases enough to bring about the death of the poor subject.

It must have fallen to the lot of most people to walk in a field of clover about an hour before the sun actually dips below the horizon. A very great change has just come over the little plants, for instead of the trifoliate leaves being fully expanded to the light and air, the leaflets are gathered together, whilst even the stalks bend slightly towards the ground. The whole appearance of the plant suggests that it has huddled itself up in order that it may keep warm; and this is actually the case. Experiments have shown that if the leaflets of a clover plant are fixed in such a way that they cannot close, and are then exposed to the low temperature of a clear night, the delicate foliage will be badly damaged. On this account a wise provision of Nature has ordained that the clover leaves shall be extraordinarily sensitive to light; this is so much the case that even on a dull day the foliage will be found to be partly closed. These sleep movements are to be observed not only in the clovers, but as well in almost all the other members of the great leguminous tribe. The pink Rest Harrow, the dainty Ladies' Fingers, the Meadow Vetchling, to mention only three common pod-bearing species, each and all show a slight change in the bearing of their foliage during the night-time.



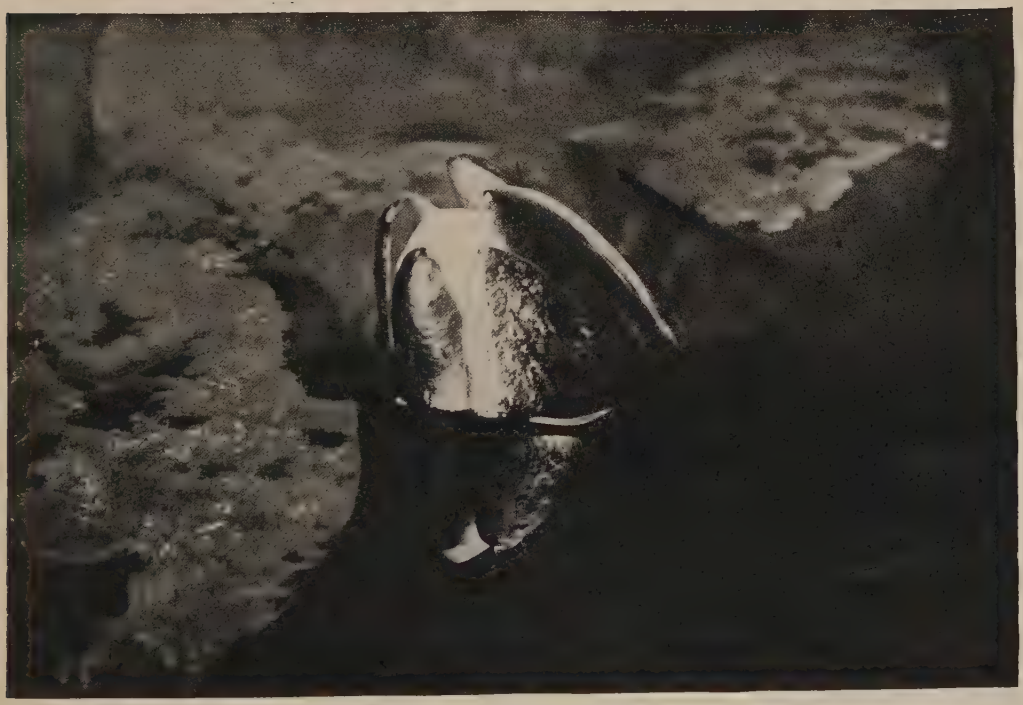
WOOD SORREL: NIGHT POSITION.

Another little plant which goes to sleep in a very pretty fashion is the Wood Sorrel. The foliage of this *Oxalis* is curiously responsive to all sorts of conditions; so much so that it may well be called the British Sensitive Plant. Even to blow the foliage briskly is to bring about a folding of the leaflets, whilst a heavy cloud will induce the gathering together of the foliage. Long before the daylight has really fled, the pale green leaves are preparing themselves for the chill dews of night, whilst the flower heads hang down in a very disconsolate manner.

DAISIES BY DAY AND NIGHT.

Although it is a matter upon which we have not much definite knowledge, there is little doubt that these day and night positions on the part of plants are brought about by changes in the distribution of water in the cellular tissue. In some way the waning light induces an alteration in the turgidity of the cells, with the result that the tissue loses its tenseness, and the leaf collapses.

It is not only in the plant as a whole that striking changes take place at the approach of evening. Quite as important as the shielding of the foliage from cold, is the protection of the pollen from damage by the heavy dew deposits. To this end some of the most beautiful adjustments in the whole floral world have been brought into being, many of these really marvellous examples of Nature's forethought. At noon the meadow grass is starred all over with Daisy flowers, but some time before there is any very appreciable difference in the degree of light, the little blossoms begin to close their "sleepy red eyes." The pollen produced by the central mass of true flowers would be seriously injured by the falling dews of evening did not the encircling florets gather inwards to shelter it from the moisture. Perhaps even more striking is the behaviour of the garden Eschscholtzia, a well-known plant hailing from California. This species is a member of the Poppy tribe, and has the typical cup-shaped flowers, which under the influence of the midday sun expand to their fullest extent. So early does the flower go to bed, however, that even at midsummer the glowing orange and yellow corolla will be folding itself up by three o'clock, whilst an hour later the whole flower will be completely closed. It is rather curious to consider how it is that the Eschscholtzia can be so quickly influenced by the waning light in the early afternoon, especially when it is remembered that the flower opens



THE WATER LILY BY DAY AND NIGHT

ESCHSCHOLTZIA: DAY POSITION.

in the morning long before the sun has attained its maximum altitude. We cannot but feel that we know very little about the real action of light upon the petals of flowers.

A very long time ago it was noticed that the Water Lily went to bed at night, and in the morning rose up to meet the sun. In his dainty "Reveille," Shakespeare tells of the "chaliced flowers that rise," and he can only mean the grandest of our native blossoms—the White Water Lily. When the flower of the Water Lily is fully expanded it is very much exposed to the elements; and although the plant grows with water all around it, the golden pollen must be kept free from moisture. Moreover, with such a large surface as is offered by the big open flower, there would be a serious loss of natural heat during the night. Even in the long June days the temperature falls very low at the coolest part of the twenty-four hours. So at the approach of evening the petals and sepals of the Water Lily close inwards, and the whole blossom, no longer spread out raft-like on the surface of the lake, sinks down until only about a third of the bud is visible. Thus in the equable temperature of the water the night is passed without injury, and the pollen is shielded from the heavy dews of the dark hours. The spare length on each Water Lily stalk makes this rising and falling quite a simple matter.

It is not by any means every plant which closes its flowers during the night-time. Plants, like almost everything else in this world, are very much the victims of circumstance, and whilst in a broad sense the blossoms may be called the children of the sun, there are quite a number of instances in which the flowers positively refuse to respond to the glowing rays. In the garden and out in the hedgerows we may find plants producing flowers—usually white or light-coloured—which all the day long are closed and unattractive; the very waning light, which means bed-time to most flowers, induces these species to expand their blossoms to the fullest extent. Two typical examples may be found in the White Tobacco Plant of the border, and the Evening Campion of the fields. Now in almost all the cases of these plants which are alert at night, it is to be found that some insect is closely associated with the scheme of fertilisation; and this particular species only flies during

ESCHSCHOLTZIA: NIGHT POSITION.

RED CAMPION AT MID-DAY.

the hours of darkness. Thus the Tobacco flowers are visited by the long-tongued hawk-moths, whilst the Campion attracts other night-flying species. It is remarkable how clearly the white discs of these flowers show up even on a dark,

WHITE CAMPION AT MID-DAY.

WHITE CAMPION AT 6 p.m.

cloudy night, at times appearing to gleam, almost as if they were phosphorescent. This effect is probably due to the exceeding purity of the white petals. It is certainly a difficult problem to solve, as to why it is that the petals of these night-blooming species are influenced in an opposite way to ordinary flowers by the failing light. Still more strange is it to observe that whilst the White Campion only displays its flowers during the night, the Red Campion behaves in an exactly reverse manner. Its flowers being coloured, would make no show at night, and we may, therefore, find them fully open under the mid-day sun. These distinct habits are all the more remarkable, when we remember that the two forms are so closely related; indeed Hooker considered that the Red Campion was only a variety of the white species. It is not a little remarkable that an alteration in colour should involve such a complete change in the habits of a plant as is seen in the case of the Campion.

S. Leonard Bastin.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," etc.

THE SHREW MICE—I

THE WATER SHREW MOUSE. THE COMMON SHREW MOUSE.
THE PYGMY SHREW MOUSE.

With Photographs by the Author

UNLIKE the allied Hedgehog and Mole, who have, in a sense, compelled observation—the one by the spiked defence with which he is surrounded, the other by the mysterious earthworks with which he surrounds himself—Shrew Mice, owing to their small size, the indeterminate nature of their runs, and their superficial resemblance to mouse kind in general, have failed to secure, either from author or artist, the attention which their qualities deserve. Such interest as they have aroused has, unfortunately for them, been chiefly of a superstitious character. Topsell pictures them as ravening, venomous, cruel and fraudulent.* Gilbert White contents himself with a description of the "Shrew Ash" ceremony, which has been copied from book to book to the present day, and has found, it is to be hoped, its last resting-place in Millais' ponderous volumes.

* "History of Four-footed Beasts and Serpents." London, 1658.

The superstition that Shrew Mice are in some fashion venomous, is ancient and widespread, and it may be in consequence of this superstition that so many pictures of Shrew Mice appear to have been drawn (at a respectful distance) from dead specimens. Such drawings tend to promote rather than to decrease ignorance, and if my photographs serve, as I trust they may, to dispel the illusion that a living Shrew Mouse's nose curls normally downwards, that there is a deep depression on the nape of his neck, and that his fur presents in life a sodden and spirituous appearance, I shall feel compensated for the labour and disappointments which this particular branch of photography have involved.

The keynote of the Shrew Mouse's character is restlessness. Most animals adopt, on occasions other than those of rest, attitudes which though suggestive of movement are nevertheless appreciably maintained. It is on the instant recognition of these attitudes, a power which

can only be acquired by an intimate acquaintance with the animals themselves, that the successful photography of small animals mainly depends. Other things being equal, the larger the animal the easier the work of the photographer.

The Shrew Mouse, however, is never still unless he is protected by cover. He may pause in his stride, as it were, and rear himself up to look about him; he may check his own progress by splaying his hind feet almost at right angles to his body and waddling on these alone; he may bunch himself into a sitting

The Pygmy Shrew Mouse.

The Common Shrew Mouse.

The Water Shrew Mouse.

THE THREE BRITISH SHREW MICE.

position with his hind feet hidden beneath him (curiously enough Shrew Mice often die sitting); but, though body and feet may on such occasions be stationary, head and snout are quivering with redoubled energy, and I have little doubt that the Shrew Mouse depends largely on the crown of bristles which encircles the latter for a clear (possibly a tactile) sense of his surroundings. The importance of these bristles (*vibrissæ*) is rendered evident by the presence of well-defined muscles to control them.

A peculiar feature of the Shrew Mouse's brain points to the probability of his possessing an extremely keen sense of *smell*. We must therefore regard his snout, taken as a whole, as a highly specialized organ, and if, as seems likely from the size and position of his eyes, his range of vision is limited, it may well happen that he finds compensation in his extended and delicate senses of smell and touch.

WATER SHREW MOUSE.
Preparing to dive.

So far as hearing is concerned, it is difficult to make any crucial experiments with a creature so nervous, restless and highly strung as the Shrew Mouse. A sudden clap of the hands will make him "jump out of his skin," but this may well be due to terror at the vibration of his surroundings. I have never succeeded in attracting his attention by a soft squeak such as will cause a house mouse to be "all ears" in a moment, nor does a human imitation of his own note, which closely resembles that of the Sabre-tailed Grasshopper (*Thamnotrizon*), appear to interest him.

His ear, nevertheless, presents certain peculiar features. The conch is circular and almost hairless, both front and back. The Shrew Mouse has the power of contracting and folding it in such a way that it may be completely concealed under the surrounding fur. Within the conch are two lobes, or valves, the upper of which is heavily haired on its borders and partly detached from the conch itself, while the lower (a smaller one) seems to be formed by an infolding of the conch, and serves to close or open the entrance to the internal ear.

To the Water Shrew Mouse this structure is probably of some service, for by means of it he can effectually prevent the water entering his ears when he dives; but it is more difficult to estimate its utility in the case of our two land Shrew Mice, and I have not been able to determine the reason why a land Shrew Mouse prefers at one time to keep his ears wide open, while at another time he prefers to keep them hermetically sealed.

In all our three species of Shrew Mice the hair is of similar structure to that of the Mole.

The velvet softness of the Mole's fur is probably familiar to most of my readers. The fur of a Common Shrew Mouse in good condition is softer still, while that of the Pygmy is the softest fur known to me. It is fortunate for him that his skin is of a corresponding delicacy, and that it would take many thousands of him to make a fashionable garment. But softness is not the only peculiarity of Shrew Mouse fur. The pelage of the Pygmy Shrew Mouse (and of the immature Common Shrew Mouse) displays an iridescence which has been compared to watered silk or to the gorget of a humming bird. To my mind, however, the iridescence is of a less blatant character, and can be more reasonably compared to the bloom on certain fruit. The

A Momentary Rest.

Characteristic Attitudes when Climbing.

On the Forage.

STUDIES OF SHREW MICE.

tinge of delicate purple which can, under certain conditions of top lighting, be seen on the shadowed portions of an orange plum, can be fairly matched by the appearance of a Pygmy Shrew's fur under a similar illumination.

The explanation of this iridescence, or bloom, as I prefer to call it, is to be found in the structure of the individual hairs, and this structure also accounts for the velvet quality of the fur as a whole. It has been very frequently stated that the hairs of the Mole are rooted perpendicularly in the skin instead of sloping with a definite "set" from front to back. I have not been able to find any justification for this statement, and I think that the absence of any definite "set" in the fur of this class of animal is to be more naturally explained by the fact that each individual hair is composed of five thicker, and four narrower portions in alternate order. Taking the hair of the Common Shrew Mouse, and starting at the root end, we find that transverse measurements at the centres of the alternate wide and narrow portion work out as follows: ·008 millimetres, ·006 millimetres, ·012 millimetres, ·006 millimetres, ·016 millimetres, ·006 millimetres, ·020 millimetres, ·006 millimetres, ·024 millimetres. From the last point of measurement the hair tapers to the tip. At each of the four narrow portions, where the remarkable fineness of ·006 millimetres occurs, the hair makes an abrupt bend, and these bends are in alternate directions. Each standing hair, therefore, yields to the touch in four different places at once, a fact which accounts not only for the velvet softness of the fur as a whole, but also for the absence of a set in any definite direction. So far as the bloom is concerned, I think we may find a certain analogy in the wavy hair, of which certain human beings are the fortunate possessors. Wavy hair tends to scatter and reflect light in opposed directions, and when, as is the case with Moles and Shrew Mice, the wave of the hair is combined with extreme fineness, a colour-effect produced by light-interference may reasonably be expected. While making the above measurements (and I would here take the opportunity of expressing my indebtedness to my friend Mr. O. H. Latter for his assistance in the matter) it occurred to me that the alternation of thicker and thinner portions in each hair, as viewed under the microscope, might arise from the hair being more or less ribbon-shaped and twisted spirally, so that one saw alternately the width and the edge of it.

SKETCH DIAGRAM OF HAIR OF SHREW MOUSE.

The possibility of this was suggested by the fact that from the root end to about the middle of the hair there appeared to be short lengths of serrations on *alternate* sides.

Successive cross sections have shown me, however, that the hair is cylindrical for the greater part of its length, and that it is only where the spear tip is reached that it tends to become elliptical in cross-section, owing to a slight flattening of the cells which compose this portion of it.

While we are on the subject of hair, mention should be made of the side glands in the male Shrew Mouse, which can best be detected by the feel of the coarser hair immediately surrounding them. They are especially developed in the spring, and as may be seen from the illustration on page 309, are situated on the animal's sides at points rather forward of the middle of his body. They consist of two oval patches (orange-coloured on their under surfaces) in the centres of which are small, thick protuberances surrounded by stiff, coarse hairs. Sections through these patches show that they are true glands, containing ducts, and the secretion from them probably helps to create the disagreeable musky odour which is peculiar to the animal, and which is most searching when the animal is annoyed. That they are not wholly responsible is

shown by the fact that the females of our three British species contrive to be similarly odoriferous without their assistance.

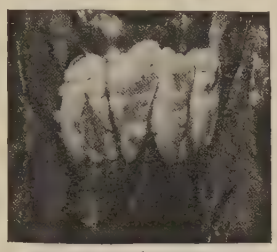
Shrew Mice of both sexes possess what are known as "hibernating" glands. These develop as winter approaches, and disappear completely in the spring. They are situated on the animal's shoulders, and consist of four symmetrical tongue-shaped masses of yellowish tissue, each about 16 mm. long, and at its widest portion 8 mm. broad. What function they perform is uncertain—it is even uncertain whether they are glands at all, or merely masses of fat. It is evident, however, from their constant and symmetrical form, and their periodic appearance and disappearance, that they are, in some way, definitely connected with the animal's winter economy.

Until quite recently it was the fashion to maintain that Shrew Mice hibernated; it is now the fashion to assert, with equal confidence, that they do not hibernate. Much, of course, depends on what is meant by hibernation, but even when we allow that the word is open to more than one interpretation, we can hardly settle the question without close observation of living Shrew Mice during the winter months. I do not know that such observation has ever been accomplished. For my own part I have found Shrew Mice difficult to keep alive for more than a few months in spring and summer, and I have never been able to tide them over a winter.

At the same time I incline strongly to the opinion that a Shrew Mouse, faced by a rapid diminution of his food supply such as would inevitably occur in a hard winter, must either relapse to a torpid condition—in which he can subsist on rare and occasional meals—or die. I have more than once recently observed a Shrew Mouse burrowing in soft soil, and his tunnel, though small, is as neat as that of the Mole, but his burrowing powers are obviously limited by his size, and the hibernating glands, whether they be true glands or merely masses of fat, afford strong presumptive evidence that, as the cold approaches, his organisation is profoundly modified.

I have occasionally trapped Shrew Mice during hard weather, but on consulting my records I have found these occasions so rare, comparatively, that I have modified my previous opinion that Shrew Mice were active from year's end to year's end.

DOUGLAS ENGLISH.



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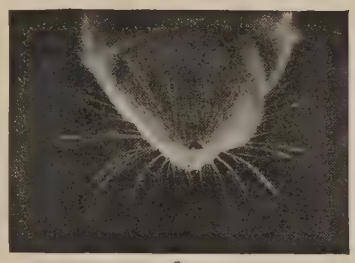


2

3

1. The remarkable "hibernating glands" of the Shrew Mouse, which develop just beneath the skin on the animal's shoulders towards the winter and disappear entirely in the spring.
2. Front view of head of dead Shrew Mouse, showing the remarkable development of the whiskers (*vibrissæ*).
3. A Shrew Mouse skin with the fur parted to show the scent glands on the animal's sides.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE MULBERRY

THE Mulberry is but a small tree. Its associations are aristocratic. The presence of a Mulberry tree on the lawn, so it is said, is itself a patent of nobility. This tree is usually found in grounds that are, or have been, attached to "stately homes." Specimens survive from far-away times,

THE MULBERRY IN WINTER.

venerable with age and reminiscent of courtly dignity. Some of these, as at Syon House, date back to pre-Reformation times, marking the site of some ancient monastic institution long since put to other uses. Many that still survive were planted in the time of James I., who made great efforts to bring about their general introduction with a view to the establishment of the silk industry here. Planting the Mulberry, therefore, became in his and succeeding reigns a matter of courtly fashion, sedulously observed by courtier nobles. So our courtly Shakespeare followed suit in his garden at New Place, Stratford-on-Avon, though house and tree both fell later under the hand of the vandal. Yet cuttings were struck from this tree and afterwards flourished, and a small specimen in direct descent may be seen in the Royal Gardens at Kew. In this connection it may be remembered that Milton also planted a Mulberry tree which still survives in the grounds of Christ's College, Cambridge.

Two kinds of Mulberry tree are found —the Black and the White. The Black Mulberry is the hardier and best suited to our English climate. Indeed, it flourishes well even in the smoke of the town. Mulberry trees annually bear fruit in the heart of London, as in the Charterhouse Gardens and in Finsbury Circus. The main difference between the two kinds of Mulberry is in the colour and texture of the leaves and in the fruit.

LEAF OF THE MULBERRY.

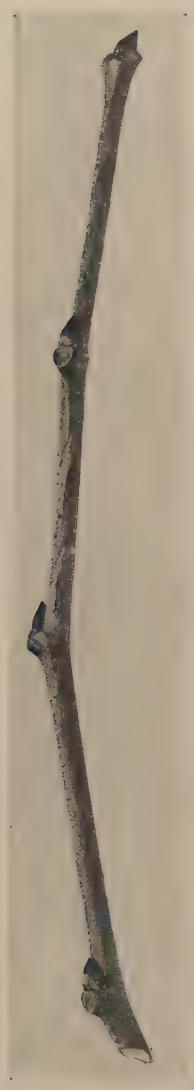
TRUNK AND BARK OF THE MULBERRY.

In *winter* the Mulberry shows sturdy branches, which commence rather low down, the lower ones often showing a tendency to take the horizontal direction. These strong branches divide and subdivide considerably in sinuous curves, ending in numerous crowded twigs.

In *spring* the tree is one of the latest to put forth its leaves, waiting till all danger from frost is over.

In *summer*, as the leafage becomes full and mature, the tree shows a dense, rounded crown, which affords ample shade, and varies in colour according to the class to which it belongs.

In *autumn* the fruit becomes conspicuous, changing from green through shades of red, and, in the black variety, to purplish black. The leaves slowly assume their yellow fading tint, but



WINTER TWIG OF MULBERRY.

remain on the tree some time after those of most other trees have fallen.

The *bark* is thick and roughened into vertical folds, reddish brown in colour.

The *winter twigs* are stout, and have the peculiarity of emitting a milky fluid when cut. The *resting buds*, arranged alternately on the twigs, are broad at the base, somewhat flattened and pointed. They are protected by scales, and stand on prominent bases. The *leaf-scars* are large, almost saucer-shaped, and show from five to seven leaf-traces, more or less grouped.

The *leaves* vary somewhat, but may be described as generally heart-shaped, though at times, especially in the case of the White Mulberry, they have one or more deeply cut incisions on each side. The margin is irregularly toothed. The colour in the black variety is a dark green, and the texture is rough and hairy; but in the white variety the colour is much lighter and the surface smooth and shiny. The midrib passes direct to the apex, with six or seven pairs of side ribs, the lower pair of which start from the base of the leaf. and each throws out six or seven strong tertiary ribs to support the lower leaf extension.

The *flowers* are distinct—the pollen-bearing from the fruit-producing. Both kinds may generally be found on the same tree, but not always. In some instances, especially in the case of the Black Mulberry, one kind only—pollen-bearing or fruit-producing flowers—will be found on a tree. The Mulberry thus shows a tendency to break from the rule observed by all the trees previously noticed. It comes midway between these and the others to be next considered, the Poplars and Willows, in which, without exception, every tree specialises, producing one kind of flower only. Evolutionary changes, though the work of long ages, are always in progress, and the Mulberry is now at the distinctly transitional point in its life-story, where a tendency to differentiate between a pollen-bearing and a fruit-producing tree becomes evident, in the endeavour to secure the positive advantage of assured cross-fertilisation. The pollen-bearing flowers are grouped into loose, catkin-like green tassels, near the base of the young dwarf shoots. The pollen dust, which is conveyed by the wind, is greenish white. The fruit-producing flowers, bunched into short spikes, stand out also about the base of the dwarf shoots, and occasionally at the junction of the lower leaves of the same with the shoot.

RESTING BUD (ENLARGED) OF MULBERRY.

The *fruit* is really a crowded cluster of stalkless stone fruits, very juicy, and with "skins" that easily rupture. This fruit cluster has the appearance of a large, somewhat elongated blackberry; though, unlike the blackberry, it is the product, not of one flower, but of many.

HENRY IRVING.

TREES

BUDS—ARRANGEMENT

Specimens required :—Twigs of Ash, Oak, Hazel. Lilac, Red Currant

Examine carefully the twigs of Ash, Oak and Hazel, noting the arrangement of the buds. Note the following :—

(*a*) *Ash.*—The buds are arranged opposite to one another.

(*b*) *Oak.*—The buds are arranged on a spiral reaching from the apex of the stem to the base.

(*c*) *Hazel.*—The buds are arranged alternately.

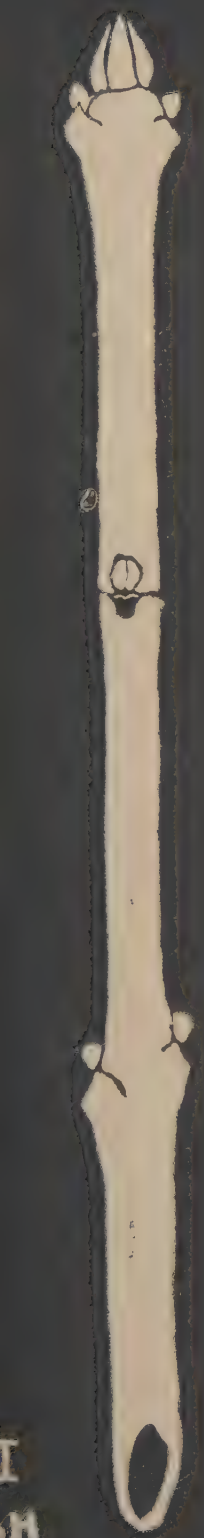
The types of arrangement thus represented are :—

1. Opposite arrangement—*e.g.* Ash.
2. Spiral arrangement—*e.g.* Oak.
3. Alternate arrangement—*e.g.* Hazel.

Collect other examples and classify on the lines indicated.

Mount specimens on cardboard divided into three sections.

Buds arrangement.



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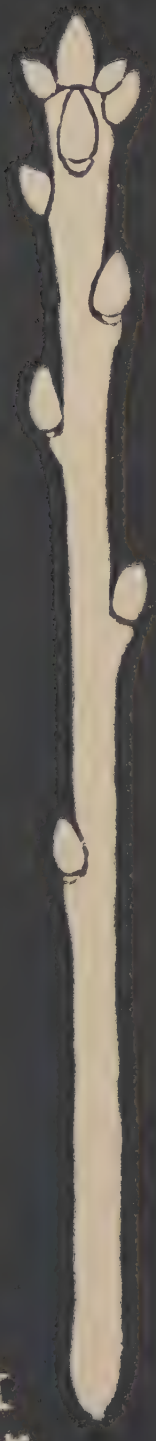
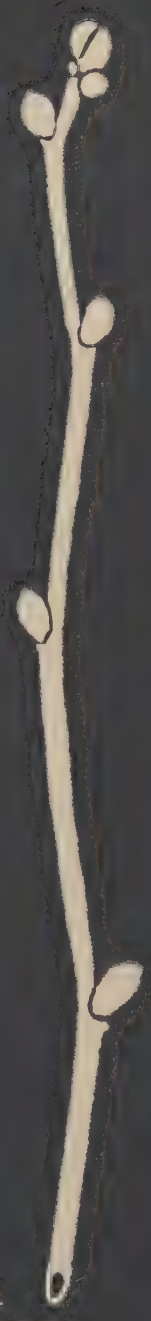


II
OAK



III
HAZEL

There are 3 Kinds of arrangements of buds -viz

I. Opposite . ε.g. ash
II. Spiral ε g oak
III. Alternate ε g hazel

THE GARDEN AT HARLEYFORD MANOR, GREAT MARLOW.
From the Water-Colour Drawing by E. A. Rowe.

Photograph by F. Mason Good, Winchfield.

"IN AUTUMN THE GARDEN DEPENDS FOR ITS CHARM LESS, PERHAPS, ON FLOWERS THAN ON LEAVES."

THE GARDEN IN AUTUMN

By H. H. THOMAS

THOUGHTS of autumn in the garden are tinged with melancholy, for this is the season of the passing flowers. How mournful, how sad is the fading of the flowers! How they are fallen! It seems only the other day that the garden was in the full flush of its beauty, brilliant with opening blossom, redolent with the scent of fragrant petals. How ephemeral is their loveliness! If only the flowers would die a beautiful death, possibly we should feel their loss less keenly, but since they droop and wither to a mass of rotting petals, involuntarily we think of the beauty that once was theirs and conjure up visions of the summer that has gone. To dream dreams of a happy past is invariably to feel dissatisfaction with the present. Thus arises that tinge of sadness, that touch of melancholy, indissolubly bound up with thoughts of autumn, not because autumn itself is actually a dreary time, but because, by unconscious comparison, we liken autumn, not to autumn but to summer. Such comparison can bring nothing but lamentation. How great a mistake it is to compare the present with the past, and especially one season of the year with another! Each season,

whether spring or summer, autumn or winter, has its own perfect beauty did we but understand and fully realise the charm of those of Nature's sights and sounds that for the time being environ us.

It is true there is nothing beautiful in the passing of the flowers, "which droop and die most melancholy." But has not autumn her own fair blossoms that even the summer sunshine cannot coax from bud to bloom, that open only when a soft haze veils the blue heavens, and a refreshing dew moistens the parched earth and wizened leaves? Yes, there are lovely flowers that delight in the waning sun, the shortening days and lengthening nights. There are many of them, and it is largely due to their presence that the autumn garden owes its magic charm—a charm as satisfying, as complete, as that compelled by the galaxy of glowing colour in summer-time. Even if we could have beds and borders gay with gaudy bloom in autumn, it is unlikely that under the grey skies and hazy atmosphere we should appreciate them. The happiest results in gardening are obtained only when each plant is allowed to blossom in its natural season—to retard summer flowers for the embellishment of the garden in autumn is a certain way to create incongruous effects. At this season how appropriate and how harmonious in Nature's vast colour scheme are the greys and mauves and lavenders, bronzes and yellows—shades that now predominate among garden flowers. The former are in perfect accord with the spirit of autumn that comes clothed in a grey shroud, as though in half-mourning for the showy summer flowers; while the latter give welcome relief and splashes of appropriate colour in the prevailing sombreness and hazy gloom. But in autumn the garden depends for its charm less, perhaps, on flowers than on leaves, for while blossoms fade with an ugliness that is depressing, leaves die a glorious death. It is only in dying that leaves taste to the full the joy of living; now is the supreme moment of their lives. From a monotonous prime they pass to an enchanting old age; as the spirit of autumn illumines them they come to their fullest beauty.

How wonderful it is that while we mourn the loss of the summer flowers, the woods and copses, the trees and shrubs are radiant with autumn's glow, which touches them to such beauty as summer never knew—a beauty that transcends the rich colour feast of June blossoms at their best! How wisely Nature orders the goings of her leaves and flowers! How perfectly the balance is adjusted! Even when beds and borders are aglow with brilliant bloom, although one may scarcely realise it, it is nevertheless true that much of their charm is due to the environment of cool green leaves, that provide such a perfect setting, such an admirable background to the many tinted flowers. The skilful gardener does not attempt to make a garden of plants that depend for their charm on flowers alone; he realises the great value of soft-toned leaves, and puts to practical use their infinite variety of form and tint, with the result that a natural garden scene unfolds.

With the passing of the flowers comes the glory of the leaves. In early autumn the garden glades are an amazing and impressive sight; from end to end a mass of colour and shades of colour all woven and interwoven in Nature's patterns by her own incomparable skill. The Elm and Oak and Beech, the Birch, queen of the woods, perfect in grace of form and tender colouring, the Rowan, Chestnut and others play their part in the weaving of the woodland tapestry; they make a picture whose impression is ineffaceable from memory, serving to bring home to one the inmiitable fascination of wood and garden when autumn falls.

> "Upon the hazel gray
> The lyre of autumn hangs unstrung,
> And o'er its tremulous chords are flung
> The fringes of decay."

What depth of wisdom lies in the ordering of so glorious a death for the leaves; it is only by comparison with the fading of the flowers that we can realise its majesty, and appreciate the gulf that exists between the beauty of the one and the unloveliness of the other. Strange that from captivating beauty flowers should fade to ugliness, while from commonplace monotony leaves die in a splendour that for the time trans-

cends everything in Nature's realm! And it is not only in the trees and shrubs that this sublime colour display is seen, although there, of course, it is most prominent, for the leaves of many a weed and wastrel plant pass to their death in dress of exquisite dye.

But Nature's own garden depends not quite alone on changing leaves for autumn charm; some of her wild plants show a rich beauty when the sun sinks in the heavens and the nights are cold and chill. There is the Traveller's Joy or Old Man's Beard, as the wayside Clematis is variously called, never more beautiful than when the flowers have given way to the feathery fruits that cover the giant shoots from tip to base with a soft grey shroud. How perfectly they accord with the environment of the countryside in autumn — of Nature's great garden of leaf and blossom — with changing leaves and the ripening fruits of Blackberry, Sloe, Crab, Thorn and Wild Rose. Even the hedgerows have their autumn beauty; the orange-red fruits of the Cuckoo Pint or wild Arum Lily peep out from the roadside ditch as if anxious to show themselves to the passer-by—little clusters of rich colour amid dead and dying weeds. The fruits of Bryony, Honeysuckle, Dog Roses,—these and others less familiar make even a wayside hedge a thing beautiful to look upon.

It is in the garden proper that autumn flowers are seen at their best, for the countryside depends for its chief beauty on the glow of the dying leaves. Within the garden it is different, although the woodland trees that encompass it provide a feast of colour and an ideal fringe. Within there is blossom in abundance, real autumn flowers that open only to the misty days and dewy nights. Perhaps finest of all true autumn flowers are the Michaelmas Daisies that give so prodigally of soft-toned blossoms which hide the

Photograph by F. Mason Good, Winchfield.

LATE AUTUMN IN A SHROPSHIRE FARMHOUSE GARDEN.

Photograph by F. Mason Good, Winchfield.

AN AUTUMN DISPLAY IN THE HON. MRS. VERNER'S GARDEN, HARTFORD BRIDGE, WINCHFIELD.

stems that bear them. Their graceful masses of grey, soft pink and tender mauve seem in perfect harmony with their surroundings, they are characterised by a softness, a pensive wistfulness that seem to possess the air and pervade the garden. There is beauty as exquisite in the subtle harmonies of the autumn garden as in the brilliant colour contrasts of summer bloom; each is fully appreciated in its season. With the fall of autumn there comes an influence that seems to alter one's point of view, so attuning one's sense of perception that the tender tones of the autumn flowers appear to have as rich a beauty as those of any other time.

There is no more charming colour picture in the autumn garden than the outer fringe, where the mauve and grey bloomed Asters are massed around the white and slender stems and beneath the golden leaves of the Silver Birch. The flowers and leaves combine to form one of the most exquisite associations of tree and blossom I have seen, one that is of the spirit of the autumn mists. Then the Japanese Anemones that throw their white blossoms so gracefully above the leaves are among the most attractive of autumn flowers. A striking garden picture results if one plants the autumn Lobelia, that bears bright scarlet blooms on bronze-coloured stems some three feet high, with the Japanese Anemones. Then the Montbretias, Sunflowers, Coneflowers, Chrysanthemums, Gladioli, and Dahlias play an important part in the autumn garden, making splashes of rich colour in the prevailing grey. And Rose and Clematis, how they glow in the drab gloom! What would the autumn garden do without Roses? Their fragrance may not be so pronounced now as in the evening of a summer's day, but there is still warm colour in the petals and a glamour that is always theirs surrounds them. Some of the finest autumn blooming roses are the magnificent white Frau Karl Druschki, Madame Ravary, whose petals are of a

soft apricot tinge, Lady Battersea, elegant in bud and light crimson in blossom, Caroline Testout, with large pink flowers, Hugh Dickson, that bears deep crimson blooms having a pronounced fragrance, Lady Ashtown, and Mme. Abel Chatenay, of salmon pink shades, the primrose yellow G. Nabonnand, and many more.

The tufted Pansies and Drummond's Phlox, in many shades of colour, that have kept the Roses company all the summer through, are still full of bright fresh bloom. Then there are Tiger Lilies, Japanese Lilies, the Golden-rayed Lily, Tuberous Begonias, Belladonna Lilies, Torch Lilies or Kniphofias, the panicled Hydrangea, Pampas Grass, the Monkshood, tall Moon Daisies; each and all bring beauty to the autumn gloom, a beauty that owes nothing to garish colouring but everything to the happy association of tender tints. And the grey-leaved plants, the Pinks, Lavender, Rosemary, Globe Thistles, Sea Holly, Giant Cotton Thistles, all are beautiful to look upon. Night in the autumn garden is an enchanting time. Even the very petals that expand to the mist-veiled sun come closer together for warmth against the dews of chilly night. And the wind as it rushes through the tree-tops chants a dirge for the dying leaves and sings a lament for the passing flowers—

> "The wind like one that sighs in pain
> O'er joys that ne'er will bloom again,
> Mourns on the far hillside."

The music of the woods is never more subtle than in autumn; its song is sad, and in its wake it leaves a trail of quivering leaves, that tremble and flutter and fall.

H. H. Thomas.

Photograph by F. Mason Good, Winchfield.

THE LAST OF THE HOLLYHOCKS.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," etc.

THE SHREW MICE—II

THE WATER SHREW MOUSE. THE COMMON SHREW MOUSE
THE PYGMY SHREW MOUSE

With Photographs by the Author

THE diet of Shrew Mice in general (the Water Shrew Mouse will be more particularly referred to later) consists largely of insects and mollusca. To this end their teeth have evidently been specialised, the long central incisors forming a pair of roughened forceps, while the molars, whose cutting edges take the form of successive V's or W's, are clearly adapted for crunching hard material. Small snails are a favourite dainty. Sometimes the snail is extracted from his fortress, but the jaws of our two larger species are quite capable of crushing a small snail-shell, and the Shrew Mouse, when roused to bite, bites with a reckless energy. I have, on three occasions, found dead Shrew Mice in my traps who had broken one or more of their central incisors in their frantic efforts to escape. I would impress upon those of my readers who may be interested in trapping small animals alive, that in the case of Common or Water Shrew Mice the traps should be visited at least twice an hour, while to have the chance of securing a live Pygmy, one should be able to sight the trap every ten minutes.

In addition to insects and mollusca, Shrew Mice will readily devour any carrion, fur or feather (a shrimp is a good bait for the Water Shrew Mouse), and probably do much more as scavengers than we are aware of. As a general rule they stand well clear of the ground while feeding, but sometimes in the case of a slippery meal—an earth-worm for instance—they employ their hands to help their teeth. They leave nothing behind which they can bite. An earth-worm is seized by one end, swung from one side of the jaw to the other, and crushed by the right and left molars alternately, growing shorter and shorter until he disappears completely. A fair-sized beetle (the Shrew Mouse is extremely fond of cockroaches also) is caught by the head, and this portion is prudently disposed of first. Small beetles disappear entirely, and the meal, which is consumed at a lightning pace, is followed by a lightning digestion. On occasion Shrew Mice will drink with a curiously bird-like action. The snout describes a small arc in the water, and at the end of its sweep points almost perpendicularly upwards.

I am not satisfied that Shrew Mice have any regular breeding season, and I am inclined to think that their breeding depends on favourable conditions of temperature and food supply. At the same time, from the recurrent mortality amongst them in the spring, one can fancy that at this season, if any, the males are instinctively most warlike. The autumn mortality has never been satisfactorily explained, but the fact that it is not invariable would seem to suggest that weather conditions have much to do with it, either by curtailing the food supply, or by actually affecting the Shrew Mouse's health. I have found captive Shrew Mice extremely sensitive to atmospheric disturbances which do not evidently affect beasties of a more robust constitution.

A duel between Shrew Mice is, as might be expected from their strenuous nature, worth watching. The commencement on both sides is circumspect. The com-

batants advance squeaking with wide-open jaws and snarling muzzles, squirm round each other, jump clear across each other, and at each other. Finally, one or the other gets a hold, often on his

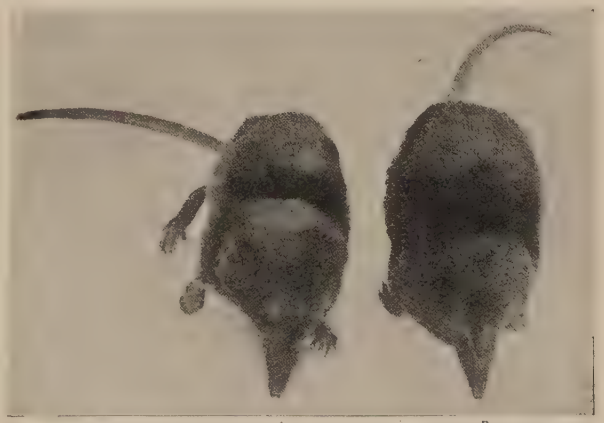
SLEEPING ATTITUDE OF THE PYGMY SHREW MOUSE.

opponent's tail, and here the real business begins. They fasten head to tail and tail to head, and spin as a living ball until the spin itself releases them. After a few seconds' rest, during which they are often lying on their backs squeaking defiance, hostilities recommence, and the rounds presumably continue until one or the other combatant is completely exhausted. I have never seen a duel which terminated fatally. On one occasion I had the privilege of watching one for nearly ten minutes, and when at the end of this time I parted the combatants, neither appeared to have received even a superficial wound.

I fancy, however, that a bloodless encounter of this kind must be exceptional, for I have often handled old males who were as scarred as Chelsea pensioners. One scar which I have frequently met with takes the form of a circular or oval patch on which the hair growth is so short that the grey middle portion of the surrounding fur is plainly visible as a ring round it. It should, perhaps, be mentioned that the "colour" of small animals is largely due to diffused pigment in the *tips* of the hair. For the greater part of its length each individual hair is slate grey or lead-coloured. From scars such as these one must conclude that the Shrew Mouse occasionally has considerable patches of skin torn bodily off him, and wounds of this description are most likely to occur in battles with his own kind.

The characteristics which I have so far described are applicable to all three of our British species of Shrew Mice. Before entering into more particular details respecting the Water Shrew Mouse, it may be well to describe the best means of distinguishing the three species. External features are sufficient to distinguish the adults. The body length (nose-tip to root of tail) of the adult Water Shrew Mouse is 80–90 mm.; that of the Common Shrew Mouse 65–75 mm.; that of the Pygmy 45–55 mm. The tail length of the Water Shrew Mouse is about 50 mm.; that of the Common Shrew Mouse about 40 mm.; that of the Pygmy a millimetre or so less. The hind foot of the Water Shrew Mouse measures, exclusive of the claws, about 18 mm.; that of the Common Shrew Mouse 12–13 mm.; that of the Pygmy 11 mm. The latter measurement, as will be seen later, is of great importance.

So far as colour is concerned, all our three species exhibit considerable seasonal variation, and the Common Shrew Mouse is peculiarly liable to freakish patches of

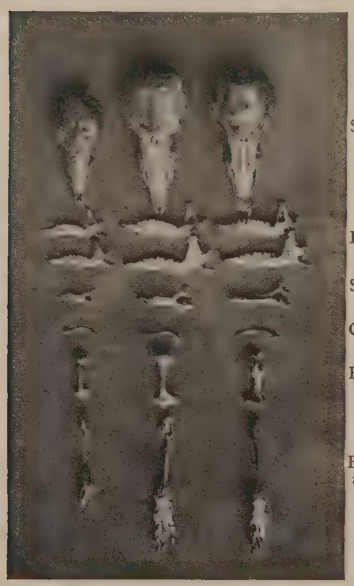


A *B*

DEAD SPECIMENS OF (*A*) AN IMMATURE COMMON SHREW MOUSE; (*B*) A PYGMY SHREW MOUSE.

The skulls and bones of the fore-limbs of these two specimens are shown on p. 320. The two specimens were approximately equal in size, but the heavier skull of *A* is evident externally.

grey or white, besides being prone to albinism. Generally speaking, however, the Water Shrew Mouse is blue-black in colour; the Common Shrew Mouse a rich warm brown; and the Pygmy a colder brown suffused with a tinge of purple. Both the Water Shrew Mouse and the Common Shrew Mouse occasionally have white fringes on their ears, and there is frequently a cinnamon band on the flanks of the Common Shrew Mouse



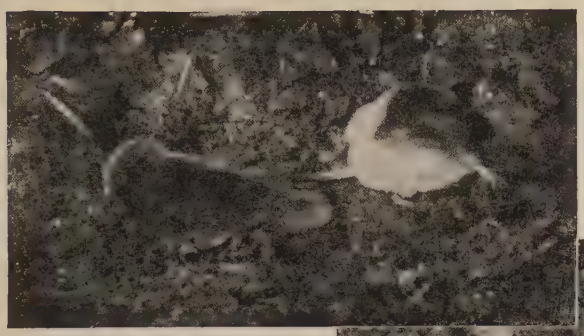
SKULLS AND BONES OF THE FORE-LIMBS OF
1. A Pygmy Shrew Mouse.
2. An Immature Common Shrew Mouse.
3. A Mature Common Shrew Mouse.

which I have never found on the Pygmy. The belly of the Water Shrew Mouse is sometimes pure white, with a sharp line of demarcation (the white is often superficially stained by continual contact with muddy surroundings), and sometimes blue-grey. I have taken the two varieties in about equal numbers. The snout of the Water Shrew Mouse is distinctly more blunt than that of the two other species.

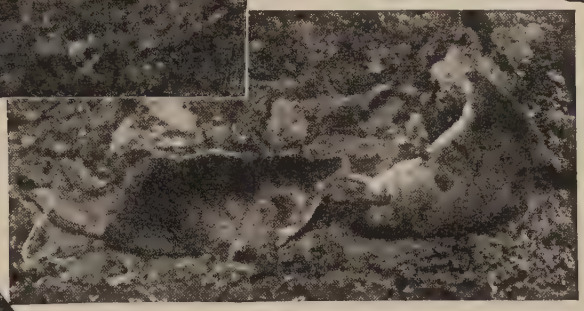
The above external features should suffice to distinguish adults of the three species, while there are certain anatomical differences in the Water Shrew Mouse (he has two teeth less, for example), which make his claim to being a good species indisputable.

When, however, we come to compare the Pygmy, the immature Common Shrew Mouse, and the immature Water Shrew Mouse, our task becomes more difficult, and is complicated by the fact that an immature Water Shrew Mouse presents occasionally a brown-black rather than a blue-black coloration. His muzzle, however, is characteristically blunt, so that our real difficulty commences when we endeavour to distinguish the immature Common Shrew Mouse from the Pygmy. This distinction can only be effected by careful external and internal measurements, for the Pygmy and the immature Common Shrew Mouse are often identical in colour, and so far as all-over body length and tail length are concerned, often identical in size. When, however, we commence to study the external dimensions of the former more carefully, and, carrying our investigation a little further, to take careful measurements of his bones and of his teeth, we find that every bone in his body and every tooth in his head is considerably smaller than the corresponding bone or tooth in an immature Common Shrew Mouse of approximately the same length. The Pygmy is, in fact, a miniature edition of the adult Common Shrew Mouse. He is exquisitely proportioned, and displays none of the legginess and want of balance which is characteristic of a young animal. I am not aware of the existence of any anatomical distinction whatever between the two species, apart from these distinctions of size. It is said that the Pygmy Shrew Mouse is the only member of the family which occurs in Ireland. If this be the case, it would seem as if a mild climate, by favouring an earlier maturity, had influenced his evolution, and it would be interesting to know the mean annual rainfall and temperature of the different portions of the Old World, ranging East as far as Saghalien, from which he has been reported. In this country I have found him wherever I have found the Common Shrew Mouse, and in equal abundance, though, as might be expected, he is more difficult to trap.

So far as breeding, feeding, movement, and general habits are concerned, I have not been able to detect any difference between these two species. The Water Shrew Mouse presents, as might be

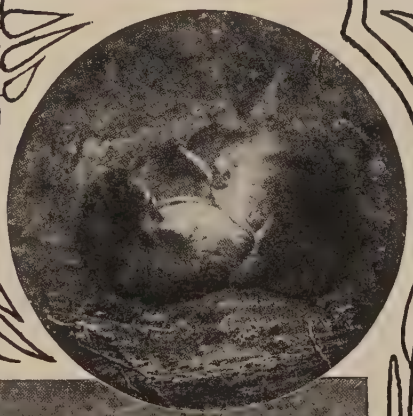


One Combatant caught by the Tail.



Feinting for an opening.

Commencement of Spin.



The Spin.

The end of the Spin.

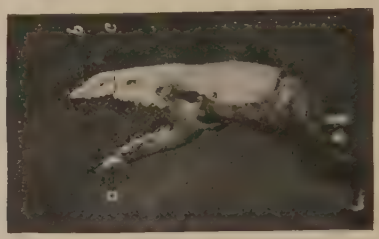
A SHREW MOUSE DUEL.

expected, certain peculiarities of his own. Though essentially an aquatic animal, the modifications of his limbs and body to suit an aquatic life are trifling. His feet and tail are perhaps more heavily

VERTICAL SECTION THROUGH LOWER JAW OF WATER SHREW MOUSE.
A, 1st incisor. B, 2nd incisor. C, Premolar. D, E, F, Molars.

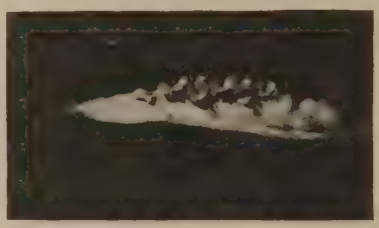
haired than those of an adult Common Shrew Mouse, though not more heavily than those of a young Common Shrew Mouse or of a Pygmy. Apart from this, the Water Shrew Mouse might be regarded, externally, as a large blue-black land Shrew Mouse, whose nose had grown fleshy with age, and who had taken to the water as a convenient way of catching fish. I have kept Water Shrew Mice in captivity for long periods, and have had frequent opportunities of watching them in the water, both at large and in captivity, at very close quarters. Like Water Rats, they hate a long immersion, which has the effect of soddening the hair on their back and head. The grey, silvery appearance which the fur of a submerged Water Shrew Mouse presents owing to the entanglement of numerous small air bubbles between the hairs, has been often commented on, but may be observed on any fur-clad animal which dives. The swimming of a Water Shrew Mouse, both on and below the surface, is a quick dog's paddle, all four feet being employed. On the surface the head is slightly raised, and three-quarters of the body are out of water. The tail trails behind, and is apparently quite functionless as regards either swimming or steering. Below the surface the head appears to be stretched forward horizontally.

When scared, the Water Shrew Mouse enters the water anyhow, and I have known one to break his back by jumping on to a stone in a pond which had been drained by pumping operations in the vicinity. In the ordinary way, however, as I have had frequent opportunities of observing, the plunge is a matter of some ceremony. He pauses, with his feet gathered together, and pushes off quietly with his hind legs. He thus keeps his head and back dry. He dives very neatly from the surface, and will do so at the slightest suspicion of danger, though a



1

a, 1st incisor. *b*, 1st incisor. *c*, Position of minute premolar.



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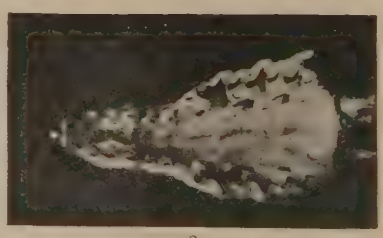


3

1. SKULL OF THE COMMON SHREW MOUSE.
2. LOWER JAW OF THE WATER SHREW MOUSE.
3. UPPER JAWS OF THE COMMON SHREW MOUSE.

A remarkable feature of the skull is the absence of a complete zygomatic arch.

The teeth are remarkable in many respects. In the three British Shrew Mice they are tipped with rich orange. The 1st incisors in both jaws are massive, those of the upper jaw being double-pronged, while those of the lower, before becoming worn, are serrated. The 2nd incisor in the lower jaw is a small tooth, and the 1st premolar in the upper jaw is microscopic.

preliminary scramble over water-weeds is often necessary.

The natural food of the Water Shrew Mouse consists, I think, mainly of mollusca. He eats these very quickly, and with the air of one who knows them. In addition,

he devours all kinds of water insects and crustacea—any aquatic creature, in fact, which is of small dimensions. He catches fish—sticklebacks, minnows and the fry of large species—by the head, carries them ashore, and devours them entire, swinging them from side to side of his jaws, and crunching them with his back teeth, as the Common Shrew Mouse crunches the worm. He appears to enjoy particularly a loach, and I have known him master a small eel after much fuss and splashing in the water.

It was interesting to note that my captive Water Shrew Mice appeared to have some notion of making a food store. In the course of a night they would invariably clear their tank of its living contents, and one would find in the morning seven or eight small fishes piled neatly in some high, dry corner. The Common Shrew Mouse does much the same with cockroaches.

Like the Water Rat, the Water Shrew Mouse prefers his bedding wet. It is possible that this is a survival of some instinct which suggests floating as the easiest method of transporting nest material, but I am inclined to think that these aquatic animals keep their bedding moist in order to lessen and alleviate the attentions of their little friends. Shrew Mice are, by instinct, scrupulously clean, and the portion of their toilet during which they are dressing their fur with one hind foot is most interesting to watch. The hind foot works with such rapidity that it appears a fan-shaped blur, and this blur travels steadily from the animal's ear to the hinder parts of him with a wake of rippling fur in close attendance behind it.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE POPLARS

THERE are three kinds of Poplar that particularly claim our attention. These are the Aspen, the White Poplar, and the Black Poplar. In addition we have the tall Lombardy Poplar, which may be regarded as a variety of the Black Poplar; the Grey Poplar, usually held to be a hybrid between the Aspen and the White Poplar; also some less common kinds assimilating, more or less, to the Black Poplar, as the Canadian and the Balsam Poplars. Of these the Aspen and the White Poplar are native trees; the others are of comparatively recent introduction.

Speaking generally, the Poplars may be described as trees with a spreading habit of growth. They are light-loving trees, and therefore are seldom to be met with in our woods, but chiefly upon the borders of these and in the open fields, preferably in the near neighbourhood of water. They have the power of putting up root suckers in abundance, so can reproduce themselves freely without depending so much upon the growth of seedlings.

In *winter* the looseness of their branching is very apparent. In the Black Poplar and its immediate allies, with the exception of the pyramidal Lombardy Poplar, the long, straggling branches and slender, wide-apart twigs produce

an effect that is almost ungainly; and all the more so because of a tendency to grow lop-sided, which is habitual to these trees.

In *spring* they put forth early, long before the leaves appear, a multitude of catkins, long and drooping, which often completely clothe the trees. The Poplars, amongst trees whose fruit-producing flowers are fertilised by the wind's agency, afford the best example of the most advanced methods for its accomplishment. They may be regarded as the standard in this particular towards which the other wind-fertilised trees are approaching. Cross-fertilisation, so essential for the vigour of the race, is here assured by the fact that the pollen-bearing and the fruit-producing flowers are not only grouped in separate catkins, but these catkins are borne on separate trees; so that we have here pollen-bearing trees and fruit-producing trees, separate and distinct. In order that the pollen dust may not be obstructed and wasted by the intervention of foliage, these catkins, growing out from lateral buds on the previous year's shoots, are produced, ripened, and their work accomplished before the leaves begin to unfold. The pollen-bearing catkins are long and pendulous, so loosely composed and hung that they shake out and scatter their pollen dust with the slightest wind. The fruit-producing catkins also, when ready to receive the pollen, are pendulous, quiver and shake, the more readily to intercept it as it is borne past. As a further precaution against failure the pollen-bearing catkins are produced in excessive numbers, so that the air becomes crowded with the floating pollen grains. Haphazard as would seem this method of distribution by fitful agency of wind alone, failure of each tiny fruit-producing flower to secure fertilisation is practically impossible. When their work is done the pollen-bearing catkins fall and litter the ground.

Black Poplar. Aspen. White Poplar.

LEAVES OF THE POPLARS.

In *summer*, by the time the leaves are

ASPENS IN SUMMER-TIME.

ASPEN (DROOPING VARIETY) COMPLETELY COVERED WITH POLLEN-BEARING CATKINS.

fully grown, the fruit ripens. Long tassels of cottony fluff hang pendent for a time, and the seeds, each with its cottony attachment, are gradually carried away by the wind. Eventually the tassels themselves, or what is left of them, fall, making fresh litter below.

The leaves of the Poplars, particularly those of the Aspen and the Black Poplar, rustle and quiver with every breath of wind, suggesting multitudinous merry life, with subtle whisperings, rippling laughter, and frolicsome joy-dance. It must be a dead calm indeed for the interplay of air and sunshine among the quivering Poplar leaves to cease. By this almost perpetual motion these leaves are able to secure increase of light and air, with quickened respiration probably, and possibly an advantage to themselves in ridding their surface of excess of moisture, aiding evaporation and shaking off rain drip.

In *autumn* the leaf changes vary, but mostly to yellow, orange and brown. A peculiarity is noticeable, especially with some trees, in that these autumn tints are at first assumed only partially, producing a somewhat patchy effect. So we see at times a blaze of yellow and gold amidst the elsewhere unchanged green.

TRUNK AND BARK OF THE ASPEN.

TWIGS OF ASPEN (ONE WITH CATKIN-BUDS), ALSO FOLIAGE-BUD (ENLARGED)

THE ASPEN

This is the smallest and shortest lived of the Poplars, yet for us it takes pre-eminence among them from the fact that it is undoubtedly a native tree. It is, moreover, the most interesting, and has the pleasantest associations. Its branches are few and slender, with a tendency to become pendulous at the extremities. With this tree the characteristic movement of the leaves is most pronounced and continuous. "To tremble like an Aspen leaf" has become proverbial. An ancient legend pathetically accounts for the Aspen's trembling: it alleges that the Cross was made from its wood, and that the tree ever since has shuddered to remember its part in the great tragedy. Yet to our view the associations of the Aspen are rather those of joyousness, of free, bounding life. Grouped beside some quiet waters, rising over the floating water-lily leaves, and the swaying flags along the margin, the clump of Aspens stands out gracious and tender, yet cheery withal, in the never-ceasing ripple over and around its leafy crowns, whilst the reflected sunshine shimmers and flashes there. Above are twinkling lights, beneath is a tremulous shade.

The *bark* is greenish grey and smooth at first, but roughens as the tree attains maturity. The *twigs* are polished, rounded, yellowish brown in colour. The *resting buds*, arranged spirally on the twigs and pressed, more or less, close up to them, are pointed, glossy and sticky. Their colour is chestnut-brown. The flower buds are larger and stouter. The leaf-scar of the Aspen, and of the Poplars generally, is usually described as semi-lunar, but it is subject to much variation. It has three leaf-traces. The *leaves* are of thin and firm texture, smooth, rounded in shape, with numerous blunt or incurved teeth. The under surface of them is lighter in colour, sometimes greyish. The stalks are long, and are flattened sideways, acting like a piece of tempered watch-spring, maintaining the tremulous motion, and distinctive pendulum-like side-swing, of the leaves. On the suckers which spring up plentifully from the shallow, spreading root system, the leaves are more triangular in shape, are without marginal teeth, and have shorter stalks. As is characteristic of all the Poplars, a single mid-rib passes from the stalk direct to the apex, with branching side-ribs, the lowermost pair of which start immediately from the base as strong secondaries in support of the lower leaf extension. The *catkins* of pollen-bearing and fruit-producing flowers are thickly covered with hairs, rendering them distinctly furry.

WHITE POPLAR IN EARLY SPRING.
Covered with pollen-bearing catkins.

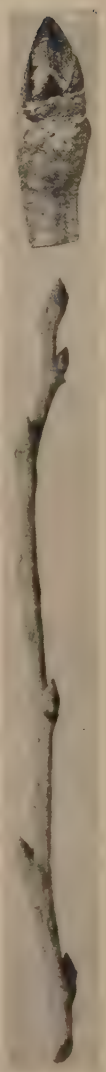
THE WHITE POPLAR, OR ABELE

This tree can also claim to be native with us. It has usually a denser crown than other Poplars, its long branches being more fully furnished with lesser branchings, twigs and foliage. It endures shade better, so may be oftener met with among the trees of the more open parts of the woods. Its leaves are much less mobile than those of the Aspen, and without their side-swing. In the wind they are flung upwards, exposing their white under-surface, giving to the tree

an almost snowy appearance in contrast with the greenery of other trees.

The *bark* is the greenish grey so characteristic of the smooth Poplar bark; but this tint, and the attendant smoothness, are with the White Poplar more pronounced, and longer retained, than with its allies. The lozenge-shaped breathing apertures in its smooth grey surface are numerous and very noticeable. Not until the tree is well matured does the bark at the base commence to roughen. The new shoots and young leaves are covered with a white cottony down, as if smothered with roadside motor-dust. This down easily rubs off. Remains of it are nevertheless found in the *winter twigs*, giving to their natural olive brown colour a greenish grey appearance. The *resting buds* are spirally arranged on the twigs, and are shorter and less pointed than those of the Aspen, not sticky, but covered with cottony down as are the twigs. The catkin buds are larger and more rounded. The *leaves* when mature are thick and tough, deep green and smooth above, with the under surface so thickly crowded with white hairs as to give the appearance of white felt; they are also felt-like to the touch. In shape they are more than usually variable. They may be almost heart-shaped with sinuous outline; or rounded, or long oval, with blunt teeth; or cut into, forming three or five distinct divisions, as is generally the case with those growing on the very numerous suckers. The leaf-stalks are shorter than those of the Aspen, very little flattened, and the leaves are carried more horizontally. The *catkins* of pollen-bearing flowers are very slightly hairy, those of fruit-producing flowers not at all. These last are green in colour.

TRUNK OF WHITE POPLAR.
Showing both smooth and rough bark.



WINTER TWIG AND RESTING BUD (ENLARGED) OF WHITE POPLAR.

THE GREY POPLAR

The Grey Poplar combines more or less the characteristics of the Aspen and the White Poplar. In habit of growth it is very similar to the latter tree, but its twigs and buds are less hairy. Yet its buds are not sticky like those of the Aspen. The leaf-stalks are rather more flattened than those of the White Poplar. The leaves are more like the Aspen's in shape, but lighter in colour and hairy on the under surface, though less so than those of the White Poplar.

THE BLACK POPLAR

This tree is black in the sense only that it is not white, being so named in distinction from the White Poplar. It is

BLACK POPLAR IN WINTER.

LOMBARDY POPLARS IN SUMMER.

a somewhat ungainly tree, awkwardly branched, straggling and lop-sided. It possesses a large crown abundantly clothed with foliage, but has a light and airy appearance from the clear green of its leaves, and their constant swaying motion. In this respect it is characterised by a like tremulousness, with the sustained rustling, of the Aspen. It is not a native tree, but is said to have been introduced into this country about the middle of the eighteenth century.

The *bark* is dark grey, rough from very early in life, becoming extremely so later, with huge irregular swellings that give it a cankered appearance. The *winter twigs* are yellowish brown in colour, slender, cylindrical, hairless and glossy. The *resting buds*, arranged spirally on the twig, are long, tapering to a point, somewhat incurved so as to press against the twig, but with the points free. They are heavily coated with balsam. The *leaves* are variable in form, particularly at the lower end, where they may be rounded or wedge-shaped; otherwise the general outline is triangular with long drawn-out drip-point. Their margins are regularly toothed, and their colour is a light fresh green. A peculiarity which is rare amongst our trees is that these leaves have practically the same tint on both upper and under surfaces. When first put forth their colour is bronze, changing to yellow; and a tree freshly in leaf, seen from a distance, looks as though it were covered with bright yellow blossoms. The leaf-stalks are flattened sideways, as are those of the Aspen. These so bend over that the posture of the leaves suspended from them is vertical, even on the upright shoots. In consequence their upper surface is always presented to view, and their habitual side-swing helps probably to counteract the effect of any shade that may arise from the overlapping of neighbouring leaves. The catkins are more loosely constructed than those of the other Poplars, and are without hairs. They are produced high up in the tree. The pollen-bearing catkins are a brilliant red, the fruit-producing catkins green.

WINTER TWIG OF BLACK POPLAR

TRUNK AND BARK OF BLACK POPLAR.

THE LOMBARDY POPLAR

The *Lombardy Poplar* is generally regarded as a variety of the Black Poplar. Its branches rise almost parallel with the main stem, giving the tree its well-known spire-like form. In nearly all other details it conforms to the habit of the Black Poplar, or with but slight variations. The thick growth of its branches, often from the very base of the trunk, should be noted; and also, when not so concealed, the multiple-pillared aspect of the trunk, as though a number of main stems had coalesced. The trees that grow with us have pollen-bearing catkins only, which cluster about the top of the Lombardy's spire. There are no fruit-producing trees of this species in Britain.

These uplifted spires of the Lombardy Poplars, especially when growing in a line, are notable and impressive. They give a distinctive character to the landscape in which they are found, suggestive of aspiration, but with none of the sombreness which seems to belong to the Roman Cypress, the only other tree with us that takes this form. The Lombardy Poplar is full of strong life, surging upwards like a jet from a water-main, or like a flame. Flame-like it is, in very truth, when autumn has turned its greenery to shining gold, and autumn winds make it quiver, and sway from base to tip, in sweeping curves, deflected, recovering; whilst autumn sunshine makes it glow "as with fire."

THE BALSAM POPLAR.

This tree also conforms closely to the habit of the Black Poplar. The main distinction is in respect of the leaves and twigs. The leaves are coarser in texture, darker green above and very light green, almost grey, below. The leaf-stalks are not flattened. In consequence the leaves are upheld stiffly, and stand out more or less horizontally, while there is no side-swing. The twigs are thicker and stronger, as is needful, to bear the increased weight, together with the greater wind-strain due to the comparative immobility of the leaves. The branches also are more sturdy, and less straggling. The whole aspect, indeed, of the tree is heavier than that of the Black Poplar.

HENRY IRVING.

TRUNK AND BARK OF LOMBARDY POPLAR.

Photograph by Prof R. B. Young

THE TRACK OF A GLACIER.

LIFE HISTORY OF A MOUNTAIN—II

By J. LOMAS, F.G.S., A.R.C.S.

WE have already passed in review some of the principal agents whose function it is to break up rock masses.

We saw that frost and sun flake off fragments which fall and accumulate near the place where the disintegration takes place. It is evident that if this action continued for a considerable time the rock would become covered with its own waste and would be preserved from further decay.

In places remote from agents of transport this actually happens, but if the *débris* comes within the influence of moving water, ice or air, the fragmental material is carried away and the rocks are left exposed to fresh attacks.

Within broad limits we can say that each tool leaves its own characteristic mark on the rock which it is abrading.

In its action the sea may be compared with a horizontal saw; it undercuts the cliff against which it works, and removes the *débris* as it falls from above. A river cuts like a vertical saw. A country which has been covered by a glacier appears as though it had been gouged and sand-papered in one direction, and scratches are left on the polished rocks showing the same trend as the direction of ice movement.

Sand carried by the wind is usually raised from the ground, and has an upward trend when striking the rock; hence the hollows it drills out are often arched upwards. (See illustration page 248.)

The resulting form of a mountain, however, does not, as a rule, depend on the action of one agent, either of uplift or decay, but rather on the cumulative and selective effects of many.

A most important factor in the control of land forms is the kind of material on which the agents work.

Limestone, for instance, usually weathers into broad uplands. The silence and loneliness of the hills are never so keenly felt as on these bare and treeless heights. The very sound of one's footstep is deadened on treading the soft and velvety grass which covers the scanty soil in places where the solid rock does not come to the surface. Even the valleys are often waterless and silent. A broad view over the upland gives no sign of the deep gorge-like hollows, and in traversing the country we are not aware of their existence until we stand on the very brink of their precipitous slopes. And yet these valleys show features which can only be explained by water action. If we come across a streamlet on a limestone moor and follow it down-stream, we find in many cases it disappears suddenly into a "swallow hole," and flows underground through joints and caves. The valleys represent thecourse of the drainage before it was diverted below the surface.

Chalk is chemically and, in its origin, closely akin to limestone, but it is soft and pulverulent, it is not strongly jointed, and usually weathers into smooth, rolling downs.

Sandstone varies so much in texture and powers of resistance that we sometimes find it in the form of great massive hills like the Brecknocks, and at other times it wears into low flat plains like the plains of Cheshire and Shropshire and the Vale of York.

The Pennine Chain is in large measure composed of sandstones alternating with shales; the former give rise to long scarped hills, and the latter are reduced to deep and fertile valleys.

MATTERHORN WITH ZMUTT GLACIER AND STREAM BELOW.

"The fragmental material is carried away and the rocks are left exposed to fresh attacks."

Slate hills have a tendency to assume a conical form, and where precipices of bare rock stand out on their flanks they show sharp, saw-like edges.

Under normal conditions the above rocks would be laid down in layers arranged horizontally. But we have seen that in mountain-building they become crumpled, contorted and fractured by internal forces, and the work of denudation is profoundly influenced by these conditions.

Internal forces also manifest themselves in the production of great reservoirs of molten rock below the surface. When these communicate with the external

Photograph by G. Bingley, Headingley.

"LIMESTONE USUALLY WEATHERS INTO BROAD UPLANDS."

The edge of the moors from Lastingham.

world they give rise to the phenomena of volcanoes. We meet with many igneous rocks in our islands which prove that our country has been the scene of vigorous volcanic activity at many times and in many places.

We cannot, at the present day, trace in our mountain topography the outlines of volcanic cones, the craters, lava streams and ashes, such as are to be seen in Vesuvius, the Auvergne, and other regions where vulcanism is still at work or only just extinct. Our volcanoes have been so dissected and worn down that only fragments remain, but they are often sufficient to reconstruct in large measure the events which took place when they were active. Antrim and the Inner Hebrides are in great measure built up of great flows of lava piled above each other in places to a height of over two thousand feet.

In the Lake District and in North Wales we have a great development of

"WE ARE NOT AWARE OF THEIR EXISTENCE UNTIL WE STAND ON THE VERY BRINK OF THEIR PRECIPITOUS SLOPES."

The escarpment of Eglwyseg Rocks, Llangollen.

Photograph by G. Bingley, Headingley.

"THE PENNINE RANGE IS IN LARGE MEASURE COMPOSED OF SANDSTONES ALTERNATING WITH SHALES."

Ingleborough. Limestone platform in foreground.

Photograph by G. Bingley, Headingley.

"EVEN THE VALLEYS ARE WATERLESS AND SILENT."

Goredale Beck, Yorkshire.

ejectamenta and lavas of ancient volcanoes. At Castle Head, near Keswick, the actual vent through which the lavas were extruded stands like a monument to the long extinct fires. Where denudation has been active and long destruction has taken place. More frequently, however, they are not so easily destroyed, and remain as outstanding masses when the country rock has been removed.

Snowdon owes its pre-eminence to

Photograph by G. Bingley, Headingley.

"SLATE HILLS HAVE A TENDENCY TO ASSUME A CONICAL FORM."

Swindale Beck and Dufton Pike.

continued, the very heart of the volcano may be exposed. The Tors of Dartmoor, Eskdale, Criffel and Peterhead are only a few out of many which might be cited where a once deep-seated liquid reservoir has been frozen into solid granite and then stripped of the superincumbent strata.

Besides the material thrown out over the surface of the land or spread over the sea floor, volcanic action results in the thrusting of sheets and tongues of liquid rock through the strata, and these, in cooling, become sills and dykes.

Some dykes are more susceptible to decay than the surrounding rocks, and in weathering they have initiated valleys and controlled the courses along which volcanic injections which have reinforced the weaker slates of which it is mainly composed. The Breidden Hills would long ago have merged into the Shropshire plain but for the fact that they were once the seat of volcanic activity. It is in the western borders of our islands, and on the edge of the continental shelf, just before it plunges into the abyss of the Atlantic, that earth movements have shown their greatest development. It has always been held that vulcanism and earth folding were in some manner related to each other, hence it is only natural that in those parts where mountain building has been most active we should also find the greatest display of igneous rocks.

The form of a mountain must also bear

some relation to its age. Some, like the great ranges of the Alps, the Himalayas, the Rockies and the Andes, were uplifted in comparatively recent geological times. They still rear their heads above the snow-line, and though the forces of destruction have carved them into isolated peaks and deeply cleft valleys, they yet retain much of their strength and beauty.

Photograph by G. Bingley, Headingley.

"AND WHERE PRECIPICES OF BARE ROCK STAND OUT ON THEIR FLANKS THEY SHOW SHARP, SAW-LIKE EDGES."
Weathered Slate, Cader Berwyn.

If we turn to the mountains of Wales and the north-west of Scotland we find they are immeasurably older. They have stood against attack through countless ages, and now represent merely the remnants of great ranges which may have rivalled the Alps in their day.

Finally, we meet with the remains of mountains whose life work is done. They have been reduced to featureless plains or low moundy flats, and unless some new manifestation of internal forces uplifts them to give a new lease of activity and life, their careers can be regarded as ended.

Thus far we have considered the history of a mountain from a point of view which deals with the mountain itself and the vicissitudes through which it passes from birth to death.

Photograph by Tomkinson, Liverpool.

"SNOWDON OWES ITS PRE-EMINENCE TO VOLCANIC INJECTIONS."

There is another aspect worthy of a passing consideration — its place in the economy of Nature. Moisture-laden winds blowing up from the sea are condensed on their flanks to form clouds and the fertilising rain. They act as storehouses for water, and give force and substance to streams all through the

seasons. Their waste is spread over the low grounds to renew and enrich the exhausted soil.

If all the mountains were reduced to the level of the sea, cloud and river would cease to exist, the silence of the hills would descend into the plain, and the earth would become stagnant and barren.

The influence of mountains on life is equally important. The varying climates experienced on the earth's surface between the tropics and the poles are reproduced on ascending a lofty mountain. Even near the Equator we get mountains whose crests are covered with perpetual snow and reproduce a climate similar to that of the Arctic regions. Ascending such a mountain, we pass from the region of deciduous trees through a zone of cone-bearing plants to the lonely lichens, and finally we enter conditions where life is impossible.

Mountains have also exerted great and lasting influences on man. In past ages he approached them with fear and awe. They were the seats of the gods, and as the encircling clouds veiled them with mystery he wove legends of heroes and supernatural beings.

Now we make them our playgrounds and seek health and recreation among the snows.

In former times mountains were effectual barriers which prevented communication between the peoples living on opposite sides. Isolation bred peculiarities in customs, language and manners, and races struggling against a stronger invading power found refuge and security in the mountains.

In the wild and unfrequented hills of the west, the Celtic races still preserve their racial characteristics, their language and their ancient customs.

"THE BREIDDEN HILLS WOULD LONG AGO HAVE MERGED INTO THE SHROPSHIRE PLAIN BUT FOR THE FACT THAT THEY WERE ONCE THE SEAT OF VOLCANIC ACTIVITY."

Perhaps we cannot more fitly summarise our brief study of the life history of a mountain than by quoting a short passage from Ruskin's "Modern Painters":

"In order to bring the world into the form which it now bears, it is not mere sculpture that is needed; the mountains could not stand for a day unless they were formed of materials altogether different from those which constitute the lower hills and the surfaces of the valleys. A harder substance had to be prepared for every mountain-chain, yet not so hard but that it might be capable of crumbling down into earth, fit to nourish the Alpine forest and the Alpine flowers; not so hard but that in the midst of the utmost majesty of its enthroned strength there should be seen on it the seal of death, and the writing of the same sentence that had gone forth against the human frame: 'Dust thou art, and unto dust thou shalt return.'"

J. Lomas.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

KINGFISHER, SWALLOWS AND CLIMBERS

THE brightest gem of British bird-life, the Skyblue Kingfisher, is the first, though in several particulars an aberrant, representative of the *Fissirostres*, the third and last tribe of the perching, or Sparrow-like birds. They obtain their Latin name from the fact that they are wide-gaped—and in the Swallow family especially the mouth is deeply cleft—admitting of wide expansion, in order to enable them the more easily to take their insect prey whilst on the wing. In the Nightjars the wide gape is surrounded with bristles pointing outwards for the entanglement and capture of night-flying moths and beetles. The tropically clad Kingfisher—a rather long-beaked, short-tailed bird, about half as big again as a Sparrow, with azure blue upper parts, dull brick red below, and red brown legs and feet—is one of the pre-eminently unmistakable birds of the waterside; not perhaps really common anywhere, but widely distributed. Shy and retiring in its habits, it haunts for preference slowly flowing streams, from which it secures small fish, water beetles, and crustaceans. It loves to perch motionless upon an overhanging bough (preferably upon a dead branch, as this gives an uninterrupted view), whence it suddenly plunges upon its passing prey, generally returning immediately to its previous resting-place, with the captured fish held crosswise in its beak. The captive, after being mercifully tapped a time or two, perhaps, upon the wood, is swiftly swallowed head first.

When disturbed the Kingfisher darts off with straight and rapid flight;

Photograph by C. Reid, Wishaw, N.B

KINGFISHER.

Photograph by C. Reid, Wishaw, N.B.
YOUNG SWALLOWS.

generally silently, but sometimes uttering a shrill "seep, seep"—and meanwhile showing off, especially if the sun be shining, its gaudy plumage to great advantage, as it skims the surface of the equally reflective water. Kingfishers move about in the severe weather of autumn and winter, haunting, perforce, the mouths of rivers and estuaries, but, like most birds which pair for life, they return year by year to the same breeding-places, working the self-same beat of water for weeks together. The chosen site is usually a hole made by the bird itself in marsh bank or riverside, but sometimes a disused water-vole's hole is used. I once found a nest in a semi-decayed willow trunk. No real nest is made, and the shiny, white-shelled eggs—with a delicate pink tinge when fresh and unblown—are deposited upon a few disgorged fish bones.

On account of its resplendent feathering the Kingfisher has ever been a favourite object with the taxidermist and milliner, and as both the artificial fly-maker and pisciculturist have likewise—though from opposite reasons—encouraged its slaughter, there is little wonder that this beautiful bird does not more frequently grace our inland waterways. Though a most unlikely attendant at a winter bird-table, I have notes of one that was a daily visitor to a lump of suet when frost and snow precluded a more natural diet.

Four members of the Swallow family are common everywhere; we will take them in order of magnitude—Swift, Swallow, House Martin and Sand Martin. All are summer migrants, the first-named being the last to come and the first to go, whilst the Sand Martin is one of our earliest spring visitors. The Swift, so named from its marvellous power of flight, is practically black—dull, sooty black—all over, with a faint suspicion of white upon the throat; the wings are very long and scythe-like, and the tail is slightly forked. It very seldom settles upon the ground, but feeds and drinks, as do all the Swallow birds, whilst on the wing. All, too, gather nesting materials in the same manner, except, of course, the mud which the Chimney Swallow and House Martin use for their plastered nurseries. All except the Chimney Swallow nest in colonies: the House Martin, or Eave Swallow, attaches its nest to the outside of buildings, the Chimney Swallow always to the inside; the Sand Martin tunnels out holes for itself in the sides of gravel and sand pits and railway cuttings; whilst the Swift makes use of holes in ruins and cliffs and under the slates or tiles of house roofs.

The eggs of all are white with the exception of those of the Swallow proper, which are spotted after the manner of the Tits'. All are double-brooded except the Swift. The Chimney Swallow alone perches on trees, except when old and

young congregate as the autumnal season of migration approaches, when great numbers of Sand Martins roost upon the reeds around our Broads, and all but the Swift delight in resting upon telegraph wires.

The Chimney Swallow alone deserves to be called a song bird, the subdued notes of this species being especially pleasing as summer begins to fail. The House Martin utters a simple twittering, usually from the nest only; the Swift's sole note is a harsh scream, and the Sand Martin is as unobtrusive in language as it is dingy in appearance. All four species are partial to the neighbourhood of water, especially in dull and stormy weather. As to distinctive marks, the Swallow may be distinguished from either of the Martins by its chestnut throat, its uniform glossy steel-blue upper parts, its dirty-white under parts, and its long forked tail. The House Martin has the rump and lower parts pure white, and its feet are also thus feathered. The Sand Martin is of a uniform mouse colour, lighter beneath. The Swift differs from the Swallow in its larger size, swifter flight, and the peculiar narrowness of its outspread wings and general sooty blackness.

The Nightjar takes up the work of keeping the insect hosts in check, which the Swallow tribe relinquish at sunset. It is far more frequently heard than seen. It is protectively coloured; its beautifully vermiculated plumage of ash-grey spotted with black and brown, the white tips to the outer tail feathers, and large white spots on the inner web of the first three wing feathers, render it a lovely object in the hand; when its large eyes, wide gape, surrounded, as I have said, with strong bristles, and curiously pectinated middle toe-nail should be noted. A distinctive habit of the bird is that it always perches lengthwise. This, together with the fact that its legs are comparatively short, render it difficult to locate in the twilight, even when attention is called to its whereabouts by its loud and protracted jarring notes; the bird itself is over ten inches in length. By day it rests on or near the ground, and chiefly frequents commons and waste lands, or woods in which there is not much undergrowth. It is the bird parallel of the Buff-tip Moth in the insect world, and provides a remarkable instance of protective resemblance to the surroundings in which its two lovely, oval, white and lilac-blotched eggs are laid upon the bare or leaf-strewn ground. Whilst toying with one another in their nocturnal flight these birds frequently clap their wings together above the back, after the manner of the Pouter Pigeon, and they also then utter a peculiarly liquid monosyllabic call-note, which sounds something like "queep."

Photograph by F. T. Newman, Berkhampstead.

NIGHTJAR ON NEST.

The Nightjar is our latest summer

Photograph by J. T. Newman, Berkhampstead.
YOUNG GREEN WOODPECKER (THREE WEEKS OLD).

migrant, and is seldom heard before leafy June has arrived, and the Cockchafers are enjoying their drowsy flights.

The Green Woodpecker may be classed with the Nightjar as being more often heard than seen; its loud and resonant laugh or "yaffle" is frequently uttered in spring and autumn. Like the Kingfisher, it is a popular item with taxidermists. Its bright scarlet hood and moustache stripe, black cheeks, white iris, and olive green back, with pale yellow rump and pointed tail feathers, make it an attractive bird for a glass-case. But the same yellow-green back is probably, where the balance of Nature is uninterrupted by man, a protective tint which assimilates with the greenery of its natural haunts. In autumn these birds may frequently be noticed on the ground, where they both walk and hop in search of ant-hills. When prying into the cracks and crevices of the bark of trees they progress spirally by a series of jerks or club-footed jumps; both feet and tail are specially developed to assist them in these peculiar movements.

The "Woodpecker tapping at the hollow beech tree" is poetically proverbial, but hollow beeches are rare, and the woodland tapping sounds are frequently caused by the Great Tit. Truly marvellous is the power which the latter small bird is able to put forth in this respect, and surprising is the noise which results from so tiny a beak hammering upon a tree trunk in the silence of a still winter's day.

The flight of the Woodpecker is strong and buoyant, though it consists of a series of curves. The nest is made in the bole or large branch of a tree, and is excavated by the bird itself and frequently resorted to year after year. The somewhat pyriform and glossy white-shelled eggs are deposited upon chips of the wood, without any further attempt at nest-making.

Our second most common Scansorial, or climbing bird, is the Wryneck, or Cuckoo's Mate, so called because it and the Cuckoo both arrive here at about the same time in early spring; both Woodpecker and Wryneck have a peculiar foot formation to assist them in their special manner of securing a livelihood, for two toes point forward and two backward. The Wryneck is a much smaller and not nearly so strongly made a bird as the Green Woodpecker; the latter is just over a foot in length, whilst the former only measures a little more than six inches. In locality of nest and colour of eggs they are similar, but the comparative weakness of the beak of the Wryneck disables it from hewing its own nesting hole. In plumage the Wryneck somewhat reminds one of the Nightjar, but it lacks the white wing and tail spots. Like the Nightjar, too, it is more often heard than seen, its "pay, pay, pay" being very penetrating, but its otherwise secretive habits and inconspicuous plumage render it difficult of observation.

The Tree Creeper, still smaller than the Wryneck, is also a regular denizen of the woods, but it resides with us throughout the year. It is a little, dull

brown bird with feeble, plaintive note and mouse-like secretive habits; it works round to the opposite side of the trunk directly one approaches the tree whose bark it is searching for insects, and is often passed by unnoticed. The best way to refind a bird of this species, after one has lost sight of it, is to stand quite still, and give it time to reach the uppermost branches; when it has ascended thus high it will fly down very nearly to the ground level, and begin to hunt again for food from the base of the same or of a neighbouring tree.

The Nuthatch also is well distributed in well-wooded districts; it excels all other British birds in tree-climbing in that it can work its way with equally apparent ease up or down the trunk or boughs of a tree. The special development of the strong and much-curved hind claw is thus justified. Its short tail is not pointed as in the three former species, nor are the feathers thereof stiff, but soft and flexible. It has the undulating flight of the Woodpeckers, and like them is somewhat conspicuously coloured, being pale slaty grey above, with a distinct black eye stripe, and chestnut red under parts; the wing and tail feathers are black, and the outer feathers of the tail have a white spot towards their base. In winter it calls attention to itself by a sharp, though not shrill, call-note—"whit, whit." It nests in holes of trees, the orifice of which it adapts to the size of its body by a stopping of clay or mud. Sometimes, though rarely, it avails itself of a hole in masonry. I saw one such recently in the west wall of a woodland outhouse. The mud plaster was cunningly contrived to match in colour and surface level the adjacent antique bricks and mortar.

Tree Creeper and Nuthatch show their relationship to the Tits in the colour and markings of their eggs. The Common Wren, though now put in a family by itself, was incorporated by Linnæus with the Creepers, and in shape and make it is not very unlike the Nuthatch. Its eggs, too, are white with pink spots, though deposited in a beautifully domed nest of its own construction. The appearance and habits of the bird itself are too well known to require description, nor can it well be confounded with any other of our common birds. It may, however, be news to some to find that the familiar Cuckoo, better known by note and name than sight, is connected with the climbers, as shown by the fact that it possesses what is called a zygodactyl foot, that is, the outer hind toe is capable of being placed at right angles with either the inner or outer front toe. In flight the Cuckoo might be mistaken for a Sparrow Hawk, but its wings are comparatively shorter, its wing flaps are much more incessant,

Photograph by C. Reid, Wishaw, N.B.

WREN AND NEST.

and it has not the rapid flight of the bird of prey. Adult Cuckoos have the upper parts of a pale blue grey, whilst the young birds are brown and black barred, and have a spot of white on the nape — another point in which they mimic the Sparrow Hawk. It is for this mimicry, possibly, they have to suffer the mobbing of harmless small birds, though the resemblance may, on the other hand, protect them from the attacks of their larger relations; for the Cuckoo is a comparatively soft and defenceless bird, in spite of the brave show of fight which a half-fledged young one will make when disturbed. Much has been written upon the peculiar domestic economy of this glad chuckling bird, but there are still questions to be answered concerning the varied colour of its eggs.

MAURICE C. H. BIRD.

YOUNG CUCKOO. *Photograph by C. Reid, Wishaw, N.B.*

A GLADE IN THE FOREST.
From the Painting by A. C. Wyatt.

A GLADE IN HYDE PARK NEAR THE MAGAZINE.

NATURE "IN TOWN"

HYDE PARK AND KENSINGTON GARDENS

By ARTHUR SCAMMELL

HYDE PARK may be regarded as the meeting-place of two worlds: a scene wherein the drama of eager human life goes on side by side with the slow calm processes of Nature.

The human picture is indeed a full one. High life and low life; kings following the chase, and outlaws hiding from justice; royal cavalcades and sorry processions to Tyburn; rank and fashion in daily parade, over against demonstrations of the unemployed; luxury in a royal palace, and tired destitution in uneasy slumber upon the park benches; loyalty doffing to the king, whilst over there the demagogue bellows upon his tub; Rotten Row upon the one hand, upon the other the Reformers' Tree and the re-erected Hyde Park railings: and between these extremes the constant coming and going of the multitude of decent citizens; not making history perhaps, but certainly making love; taking the air with their wives and children or, at the least, exercising their dogs. An epitome of London is Hyde Park—a pageant of English history.

For the Nature side of the picture we have six hundred and thirty-six acres of gardens, pasture, lake, and plantation, wherein five or six hundred varieties of trees and shrubs are growing, mostly

under quite natural conditions; where for the greater part of the year two flocks of sheep are grazed; where rabbits live in a warren, and water-voles enjoy their native element; where numerous singing birds, with jackdaws, crows, and doves, live and breed, whilst land and water are frequently visited by strange and rare

A LONDON PASTURE: HYDE PARK.

species; where bees and butterflies hover over the flowers, the dragon-fly gleams in the sunshine, and bats and moths flit abroad at dusk.

I suppose no trees in the world have seen quite so much of human history as the oldest of the elms in Hyde Park. Take that scattered party of veterans—remnants doubtless of an army—dotted about the neighbourhood of the Royal Humane Society's house by the Serpentine. With worn and hollowed trunks, dismembered again and again by the hand of man and the ravages of tempests, they still make a brave show of summer green, and live on; the dignity and the feebleness of age alike protected by the decent iron railing. They live, all but one; he leans there, lifeless but not fallen, stayed with doubtful compassion by iron crutches; like dead Cæsar, with his mantle of ivy drawn over his head.

Hard by here, two centuries ago and more, was the famous Ring—a much contracted Rotten Row of the time—where the coaches of the great used to drive round and round that the world of rank and fashion might see and be seen. Mr. Pepys' coach amongst them, varnished to "make it more and more yellow, with the horses' tails tied in red ribbons, the standards gilt, and green reines, so that people did mightily look upon us."

"My Lord Protector's coach, too, with his three daughters all in green," hunted by the multitude of sight-seers. My Lord Protector himself, essaying to drive his own coach, and lashing the horses furiously, so that he was run away with, and violently thrown; his pistol going off in his pocket. The restored Court in laces and periwigs. Hanoverians and Jacobites. The plague-stricken camp of

The Avenue.

Near the Serpentine Bridge.

IN KENSINGTON GARDENS.

1665. Refugees from the Great Fire; duels, coronations, Crystal Palace—the old elms have seen it all. Well may they wear a grave and reverend look, as those

"That have kept watch o'er man's mortality."

But in truth the trees are not at all concerned with man and his doings; bourne only known as a brook which ran across to Westminster under Knight's Bridge, feeding the ponds on its way. Hyde Park, therefore, was quite in the country; an enclosed piece of the County of Middlesex.

Middlesex, the homeliest of the home counties, where no one looks to be excited

THE WATER GARDEN: HYDE PARK.

their fealty is to the great god Pan; their business to draw by rootlet and leaf the meat and drink they need from the earth and air. For the life of vegetation has the greater strength of slowness and endurance; the earth was green before we came upon it, and green will be the grave of the last man. And it is a sense of this dominance of Nature which causes some of us in Hyde Park to-day to get away as far as may be from the ephemeral people, and sit in solitude upon the carpet of grass that will never wear out, and look up into the everlasting roof of the branches.

In Mr. Pepys' day, Kensington and Bayswater were small villages, and West- by fine scenery; but where trees are many, and the lanes long and quiet; where the colouring is always subdued and restful; dark and cool in summer, and in winter still soft and verdant; the paradise of the haymaker, the land of the meadow and the elm tree.

It seems quite in the natural order, therefore, to find the elm the dominant tree in Hyde Park. The tree of the homestead and the hedgerow, never of the forest: of the country, but not of the wild; not quite a city tree, but never far from human neighbourhood. The silver birch needs the mountain slope and the brook for environment, the beech the chalk hills, whilst the oak should

THE DELL: HYDE PARK

"muffle round its knees in fern" far in the depths of the forest. And the call of these wilder trees always seems to be "up and away," but the elm says "it is good to be here."

For the well-being of the trees, as well as for the general safety, it is necessary often to remove large limbs from the older timber, and in this the elm suffers less than oaks and other trees, which extend their branches horizontally (for naturally it is the horizontal branches which are most commonly sacrificed). If allowed an ample space, the elm can make as great a spread as another; but its chief glory is in its height; the elm is essentially a soaring tree, and its noblest branches strike always at the sky; only leave it its stature and the dignity of the tree will be maintained.

Others of the elder brethren have not fared so well as the elms in the battle against time and all the other ills that trees are heir to. The sweet chestnuts which Caroline, Queen of George II., planted when she filched land from Hyde Park to add to her gardens of Kensington Palace, are scarcely more than the relics of trees; picturesque as noble ruins always are, and still with much of strength in their old trunks, and vivid life gleaming in the clean serrated leaves: still "they bring forth fruit in old age," though perhaps one should not expect ripeness and edibility from those prickly burrs.

Hollow trunks, ridged and twisted bark, with stumps for limbs and branches dead and bare, how strong and how pleasant the contrast between these and the younger trees planted amongst them; slender soaring limes, feathery ashes, and stripling silver birches. Crabbed age and youth happily living together.

The oaks probably never made a great show here. They cannot learn, one thinks, to love the London clay, and it is certain they will not abide the London smoke. Here and there may be found amongst the younger oaks healthy and well developed trees, and one may yet sit beneath the crooked horizontal boughs and see the sky above fretted by the lovely pattern of the oak leaf. We of to-day may do this, but, unless we learn to purge our air from smoke and a hundred noxious gases, our children's children will look in vain for a London oak.

The sward in the less frequented parts of the Park is particularly pleasant with a warm and comfortable kind of pleasantness; the great diversity of the grasses, and the prevalence of agreeable "weeds," give it the appearance and firmness of old and mellowed pasture—which indeed it is. It is not too much to suppose that some of this may be actually virgin turf, the very sward that was trodden and cropped by the deer of the old forests of Middlesex.

Moreover, it is quite clear that the Kensington Garden fairies, at one time grown rare and even supposed by many to have become extinct, but which in these latter times have been fully rehabilitated by Mr. Barrie and Mr. Arthur Rackham, dance upon the grass a good deal of moonlight nights, for here in evidence are many of "those green-sour ringlets, whereof the ewe bites not."

A city park, however pleasant, is not the country; the best it can do is to suggest the country, and it is the wonder of Hyde Park that, shut in by the countless streets and buildings of London, it does this so well.

In the evening of a showery day in autumn (showers clear the air—and the ground—the populace not loving rain) one may go into the Park and scent the grateful moisture, and the odour of fallen leaves, and see boughs and sky reflected in little pools of clean rain water. The contemplative visitor will naturally drift to the quietest part of Kensington Gardens, and look toward the west, where the sun is going down amongst stormy broken clouds; he will admire once more the alchemy which turns London smoke into curtains of dusky gold—gold mingled with fire. And when the colour dies out of the sky, and the shadows deepen under the trees, there will steal into the mind a sense of the shadows which the same evening hour is spreading in the hollows of quiet hills all over England. And the breeze which murmurs in the planes overhead will sing, in ears unhearing for the time the sound of London's traffic, the song of the forest and the mountain pine.

When one thinks how many lives of

town dwellers are enriched by hours passed thus, it is possible in part to realise the magnitude of the debt London owes to this beautiful pleasure ground.

If I had been a man—such an one, say, as George Gissing—an inveterate lover of the country, yet compelled by unkind destiny to pass, in poverty and toil, the best part of life in London: if the changing seasons had been scarcely known except by the increase of heat or cold; if the snow had never been to me a pure thing, but only seen smirched on the roof and fouled in the gutter; if I had the bitter knowledge that my natural heritage—insufficient at the best—of summer days had been lost, and the iron had deeply entered into my soul—then, if I were, like Charles Lamb, suddenly to receive my manumission and find myself at last free to fly away and be at rest, I would spend my last evening of city life in Hyde Park. I would traverse the open spaces whence the houses are only to be seen in glimpses between green boughs; I would walk the long avenues, and let my feet rustle amongst the dead leaves; I would note the harmony of clustered sheep beneath the trees, and regard with mild reflected sympathy the whispering lovers; and when the day had come to an end, I would turn and speed away to lose myself in the heart of the west country.

KENSINGTON GARDENS: NEAR VICTORIA GATE.

Thus would I forgive the city for my long imprisonment; so would I say farewell to London; through this green vista should it ever after be seen; and when memory would recall the sorry picture of mean districts, over against it I would set the grandeur of the Broad Walk. The thought of the unclean turmoil of streets should be softened by recollection of that tiny spot of evening calm, the Dell; and even that darkest cloud of all, the misery of the poor in their squalid homes, would be lightened by the memory of the children at play, and lovers in their happiness in Hyde Park.

ARTHUR SCAMMELL.

THE WEASEL.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE STOAT AND WEASEL

With Photographs by the Author

THE subjects of my next two articles, the British Weasels, are animals belonging to an entirely different order, and displaying entirely different characteristics to those we have already considered. The Order Carnivora embraces, on the one hand, some of the most bloodthirsty and untameable animals known, on the other, the completely domesticated dog and the semi-domesticated cat. It is not a little curious that primeval man should have gone to this order for his choice of home companions. One would have thought that he would have turned more naturally to the apes. He may have done so and found the propinquity too embarrassing. Be this as it may, there seems little doubt that the domestication of the dog was due to man's discovery that an intelligent hunting carnivore was well worth its keep; while the later adoption of pussy into a somewhat elastic home-circle may have had its origin in the rescue from the pack of some helpless kitten, whose prettiness led to its being retained as a plaything for the children, and whose mouse-killing instinct was quickly appreciated in an

age which was learning to husband grain.

As the name implies, the Carnivora are essentially flesh eaters, and it will be soon realised by any one who keeps them in captivity, that it is on this flesh-eating habit, which is at once predatory and combative, that their ferocity under natural conditions very largely depends. The matter can easily be tested by modifying the diet of small Carnivora kept under conditions which allow them scope for unlimited exercise. If allowed to kill their own provender, or fed exclusively on raw meat, they will almost always be morose, uncertain, and snappy; while if they can be coaxed (I use the word advisedly) to take a mixed diet of cooked meat, milk and vegetables, their ferocity will diminish, and they will often display unexpected and, owing to their intelligence, peculiarly winning forms of affection towards their keepers.

The taste of warm blood seems to have an extraordinarily stimulating effect on the nervous organism of a carnivore, and the phenomenon of "killing for killing's sake" (an extremely remarkable one in a wild animal), may be ascribed to this stimulating effect, heightened by irritation at the disturbance of a hard-won meal.

A Stoat in a hen-house, for example, would probably content himself with a single victim, if it were not for the outcry of the victim's relatives.

The Weasel family (we have four species in Great Britain: the Stoat, Weasel, Polecat and Marten) has always attracted considerable attention from humanity, partly on æsthetic, partly on commercial grounds. Most ladies to whom I have shown a Marten in full winter pelage have betrayed, even if they have not openly expressed, the opinion that his fur might be better displayed; while the annals of trapping in northern latitudes afford remarkable evidence of the lengths to which human endurance can be driven to gratify the demands of fashion. The word "ermine" has acquired a regal significance; it is inseparable from a description of State robes; it becomes "judicial" in token of its connection with the Crown; yet "ermine" is no more than Stoat's fur. The Stoat is a small animal, and it takes many of him to make a capacious wrapping. How many, the reader can judge from the fact that each black tag on the white of an ermine robe is, or should be, the tip of a Stoat's tail. Fashion has decreed that, to be valuable, a Stoat's fur must be white, and, since this change to whiteness is a seasonal one, and does not regularly occur in temperate latitudes (though even in the south of England white Stoats are less uncommon than might be supposed), the value of "ermine," or rather that part of the value which is not fictitious, is due to the hard conditions under which the trappers have to work.

The seasonal whitening which occurs in several northern animals at the approach of winter, is a remarkable phenomenon. To begin with, it should perhaps be stated that most animals which have to compete with marked climatic changes of temperature moult to a greater or less extent during the summer months, and produce a fresh crop to meet the severity of winter. A question which has excited some controversy is whether, in cases where the winter change includes a loss of pigment, there is a gradual whitening of brown hairs or a new growth of white hairs. It is generally conceded that the colour of hair, as a whole, is due to pigment contained in the cells of which the tip of each particular hair is composed. Metchnikoff has shown us that the whitening of hair, which is an accompaniment of old age, is due to the consumption of this pigment by phagocytes, who, after accomplishing their unholy purpose, retire glutted under the skin, or quit the body altogether. This leaves the pigment cells empty, and the reflection of scattered light (as opposed to its previous absorption), partly from the surface of the hairs, and partly from minute bubbles of gas in their interstices, gives the effect of whiteness which is familiar in snow or powdered ice. In the same way the whiteness in the Stoat's winter pelage is due to absence of pigment in the individual hairs. The great difference, however, between age whitening and seasonal whitening lies in the fact that, whereas in the former the power of reproducing pigment is lost, in the latter it is merely suspended.

In summer pelage the Stoat has little

white fur about him. The lighter portions of his body have a primrose, even a sulphur tint. The seasonal whitening proceeds from his belly upwards, the last portions to change being in order, the ridge of his back, the crown of his head, and a brown ring round each eye.* It is noticeable that these portions have little, if any, fat underlying them, and it has been suggested that the vital energy

YOUNG WEASEL.
Compare with the adult animal in similar attitude on the opposite page.

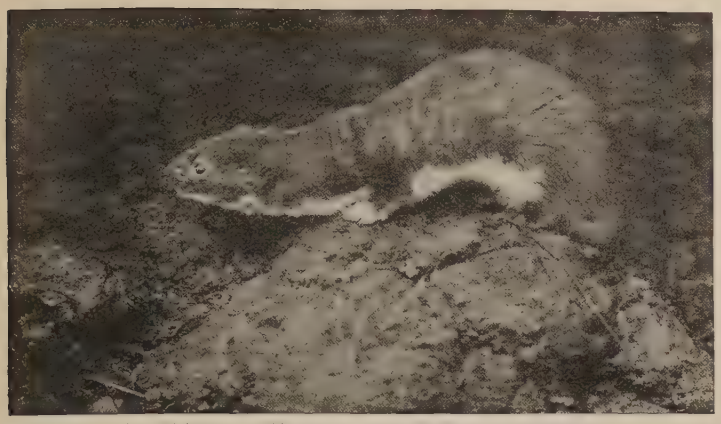
which in summer is expended in the formation of pigment, is in winter diverted to the formation of fat, or to the production of a thicker growth of unpigmented fur.

The change, that is, is due to a sluggish metabolism, with deficient oxidation and consequent fatty degeneration—almost a case of anæmia. This necessitates the assumption that the pigment is directly derived from the colouring matter of the blood. In the light of modern research, it seems more reasonable to suppose that the effect of cold, and perhaps gloom, on animals which whiten in winter, is little more than skin-deep. Pigmentation is now supposed to be due to the act of a ferment on a proteid (tyrosin) in the epidermal cells, and, if this supposition be correct, it is not improbable that a climatic change to cold and gloomy conditions would check the fermentation. Whether this would result in a blanching of the existent hair, or a growth of new white hair, would depend on the more or less forward condition of the fur when sunless cold set in, and on the degree and continuity of the sunless cold to which the skin beneath it was exposed. I have had no experience of Stoats whitening in captivity, but so far as the moult is concerned I have found that all our Weasels shed their coats copiously in May and June, and that from about that time the winter coat is gradually acquired. I have not been able to distinguish any marked growth of fresh hair in late autumn.

The Stoat and Weasel are the most familiar of our Mustelines, and I propose in this first instalment of my article to confine myself to them. To begin with, I would invite the reader's attention to their beauty of form, and I have little doubt that this beauty will come to many as a surprise. The glimpses which one obtains of a Stoat, or Weasel, at large are generally of but momentary duration, while the conception to be derived from dead specimens, whether gibbeted on the keeper's tree or mounted in the museum, is seldom even approximate to the truth. It is due, nevertheless, to such a conception that the peculiarly sinuous, lithe body, the graceful mobile neck, the short but finely balanced limbs, have been described as "vermiform"; that the animals themselves have been contemptuously and ignorantly classed as vermin; and that the very words Stoat and Weasel have gradually acquired a sinister meaning. From a predatory point of view there is little to choose between the Stoat and his human enemies; while from a purely sporting point of view the balance is somewhat in favour of the Stoat. "Stoat," or "Stot" in its original meaning, almost certainly denotes "stout" or "bold," while "Weasel," which is found in most Germanic languages, may possibly have the same origin as the Swabian *wuseln*, which means "to skip about."

Playfulness is a marked characteristic of both animals. I have watched a Weasel skipping backwards and forwards across a water-course, for no other reason which

*O. V. Aplin, *Zoologist*, May, 1898.



A WEASEL WITH HIS NECK FULLY EXTENDED.

I could discover but the mere joy of living. In countries where the cult of game has not yet reached the commercial stage, the names of the Weasel are mostly affectionate diminutives. The Italian *donnola* for example, meaning the "little lady"; the Spanish *comadreja*, "godmother"; the Bavarian *schönthierlein*, "pretty beastie";* while our own provincial "fairy" shows that our forbears regarded the little creature with an affection which was based, not only on its playfulness and elegance, but also on a common-sense view of its utility.

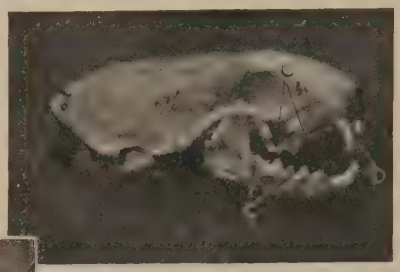
Apart from their relative sizes it is easy to distinguish between Stoat and Weasel by their tails. In the Stoat the tail is long, and terminates in a bushy black tuft, which never whitens in winter. In the Weasel the tail is short, and displays throughout its length the russet colour of the animal's back. Both animals show such variations in size (the males are always the larger) that it is difficult to assign to them definite dimensions. The extreme allover measurements I have encountered are: Male Stoat, 18 inches; Female Weasel, 8 inches. In the Stoat the tail is rather less than half the length of the head and body. In the Weasel it is rather more than a quarter. I have never found any primrose or sulphur tinge on the under surface of the latter, and so far as the distribution of brown and white on the feet and lips is concerned, I have never found two animals of either species identical. Examples of albinism in Weasels are by no means infrequent, but this is, of course, a different matter to seasonal change, and I know of no instance of the latter occurring in this country. Both animals are well whiskered, and have, in addition, a few stout *vibrissæ* on the elbow joint, which no doubt are of service to them when groping their way after dark. Though I have not been able to determine by measurements that the Weasel's neck is proportionately longer than the Stoat's, the appearance of the former,

ADULT WEASEL.

*E. von Martens, "*Ueber Thiernamen.*"

when alive, certainly gives one that impression. This may, in part, be due to the frequency with which he flings it back or swings the whole stretch of it at right angles to his body.

There is considerable resemblance in the habits of the two species. The evidence that families of them hunt in packs, and that they hunt mainly by scent, is incontestable. Packs of both species have been known to attack man. Indeed few wild animals are normally so fearless, though I have known individuals the reverse. I remember once meeting a Stoat sauntering down one of the gravel walks of my home. I waited for him to pass. Without changing his pace, he came, with his head held high and his tail waving from side to side, to within a yard of my feet. He had a good look up at me, stamped impatiently with one foot, and made some offensive remark. Then he walked away (I can hardly call it retreating) with the same dignity as that with which he had approached. Once only he paused to look back over his shoulder, show his teeth, and make the same remark. I have known another come into an out-house in which I was lying up to shoot sparrows, and on discovering me, set his back against the wall and scream until I humoured him by withdrawing. I have known another chivying sparrows on a main road, on either side of which were fields crowded with fruit-pickers. This was about 3 p.m. on a blazing July day. I was fortunate enough to sight the Stoat about fifty yards off, and was able to get a clear view of his proceedings through a field glass. Amusement rather than food was his object. He would wait until a covey of sparrows were busily engaged in their usual occupation, creep along the cover at the roadside, and leap with a beautiful swing into the midst of them. Up would fly the sparrows, to settle down a few yards further off. The Stoat would repeat the manœuvre from the opposite side of the road. Seven times he put the sparrows up, four times by jumping into the midst of them, three times by running through them. On the latter occasions the nonchalance of the birds was amazing. When he jumped they flew up in a body as one would expect, but, when he ran through them, they merely made way for him with a hop and a flutter, and were back to their occupation almost before he had reached the farther side. The impression one gained was that the Stoat was using the sparrows as playthings, and was



SIDE VIEW OF A STOAT'S SKULL.

Showing the typical dentition in a carnivore. Points of interest are the extremely large size of the canines (D), the "killing" teeth, and the two carnassials (C), in the upper jaw the 4th premolar, and in the lower jaw the 1st molar. These come together like a pair of shears, the upper being outermost. The teeth in front of these have cutting edges, those behind are rounded.

UNDER SURFACE OF A WEASEL'S SKULL

In this picture the articulation of the lower jaws with the skull should be noticed. This articulation, which is typical of carnivorous animals, is formed by a transverse development of the condyles (C) fitting very closely to the glenoid cavities (G). The power of the jaw is thereby greatly increased, and the possibility of any side play which might lead to dislocation correspondingly diminished.

YOUNG WEASELS.

making them jump merely for the fun of it.

The question whether Stoats and Weasels have the power of fascinating small birds by gambolling before them is of interest by reason of the number of observers who honestly believe that they have seen this power exercised. For my own part I have never had such good fortune. I have seen both Stoats and Weasels "mobbed" by small birds. On one occasion I remember getting close to a "mobbing" on a foggy October morning. A Stoat was up a walnut tree some twelve feet from the ground, while a heterogeneous pack of small birds were behaving in much the same way as they will in the presence of an owl. I had a good view of the Stoat, who listened to their hysterical twitters with complete indifference. "It never troubles a wolfe how many the sheepe be."

This Stoat, on sighting me, leapt straight to the ground and vanished, for which retreat a peculiarly arrogant-looking robin appeared to take credit.

I have seen a Weasel actually playing while small birds were mobbing him, and he again showed complete indifference to his surroundings.

Given an excited assemblage of small birds engaged in mobbing a Stoat or Weasel, who treats them with contempt, it is likely enough that an individual may occasionally overreach himself and fall a victim to his own imprudence, not to say impudence. This, however, can hardly be credited to "fascination,"

THE STOAT.

The head in this picture should be compared with that of the Weasel at the commencement of the article.

nor need the partial paralysis, which seizes on hare or rabbit when Stoat or Weasel is close upon them, be attributed to some occult power exercised by the pursuer. It is more likely to be the result of terror and exhaustion combined. I have seen a rabbit drag itself through the hedge-row and drop dead in the middle of the road without a sound. I have seen another stop short in mid-field, and heard it scream until the Stoat reached it. I have seen a Stoat leap on a rabbit which was sitting motionless with closed eyes stark in the open. In connection with all these cases it must be remembered that probably they are the *finish* of the tragedy. It must be a grim business from the start. One can fancy

the rabbit's instinctive sense of danger; his rush to the burrow; his feeling, call it conscious or unconscious, as you please, that the pursuit is not shaken off; his rush to the open once more; back to the burrow; back to the open; to the pursue that quarry with relentless insistence, and the hare or rabbit, as the case may be, is cognisant, not of the pursuer, but simply of being pursued.

A Stoat's or a Weasel's larder is usually a mixed one, and bears ample evidence of

THE STOAT.
The picture shows a frequent but momentary attitude which he adopts in stalking.

field; to the thicket; to the haystack; anywhere; till at the last his limbs refuse their office. But for such conditions it is hardly likely that the larger animal would be mastered. The disparity of size between Stoat and hare, or Weasel and rabbit is very great, and instance after instance has been recorded of a doe-rabbit with young turning the tables by vigorously pursuing the Stoat or Weasel, while a double-barrelled kick from a leaping buck-rabbit would assuredly break the back of either of our small Mustelines. It would seem as if Stoats or Weasels instinctively adopted wearing down tactics before attempting the *coup-de-grâce*.

Once they have set themselves to hunt, and selected their quarry, they his hunting skill. One such which I excavated at the roots of a hawthorn contained three blackbirds (doubtless caught roosting above), a young rat, several meadow-mice, and two mummied frogs. I secured the owner of this, as dainty a fairy as I have yet encountered, a bare six inches from nose-tip to root of tail, and small all over. In West Kent these diminutive (female) Weasels are known as "kines," and I fancy that this word occurs in other parts of the country, the vowel being modified to suit the dialect.

I have no experience of young Stoats, my only acquaintance with them having been a dim uncertain view in the recesses of a hollow tree. During the quarter of an hour I was absent in search of an imple-

THE STOAT.

ment with which to enlarge the entrance, the mother very properly removed them. My experience of young Weasels is more definite. In May, 1904, I secured a litter of five during the threshing of an oat-stack. They were of the same colour as adults, well-furred, but blind. Four days after capture their eyes opened. Their note was a high whimper, and could be exactly imitated by rubbing a moistened finger on glass. They quickly took to sparrow-meat, and, when I had had them a fortnight, their whimper ceased, and they developed the power of "hissing." This always occurred under cover. A Weasel under cover, who suspects mischief, arches his back and gathers all four feet beneath him. He may or may not hiss. His "yap," the ultimatum, is accompanied by a lightning lunge, and recovery of the head, neck, shoulders and fore-part of the body. It is impossible to disregard the serpentine character of this attack. Personally I could never face it without flinching. Apart from this muscular adaptation to quick forward movement, the anterior portion of a Weasel's body admits of an extraordinary amount of lateral play. A favourite exercise of my Weasels, when full grown, was to swing the fore-parts of themselves from side to side through something like a right angle, at a rate which I timed on several occasions of 150 strokes a minute. Another example of this body flexibility was seen when a pair quarrelled. Before one got a grip of the other it was impossible to follow the inextricable confusion of their bodies. I never saw the throat grip, which presumably was intended, but on several occasions I saw one fasten on the other's nose. The victim's procedure was always the same. He flung his hind-quarters off the ground and twisted completely round. The aggressor of necessity followed suit, and the pair formed an animated spiral, the revolution of one body being a shade in front of that of the other. I have counted twenty-three such revolutions in succession.

In spite of the evidence of Weasels hunting in packs, to which I have already referred, I should judge the adult Weasel to be normally a solitary animal. In the case of a pair of my captives, each had his own corner of the cage, which he defended *vi et armis* against his fellow. Frequently they fought, and in the end one killed the other; yet at times they played like puppies. The game was hide-and-seek, one taking cover, waiting till the other approached, yapping at him, and, if he retreated, pursuing him round and round the cage and up and down its wire-netting side. As in the case of dogs, it was easy to distinguish these mock combats from the real thing. The Weasel has two characteristic methods of running. In one he keeps his body very low and straight. In the other he progresses by a series of bounds, and at the top of each bound his body is strongly arched with all four feet together beneath him. He frequently adopts this dancing method when he has to carry a small bird, or mouse, over rough ground.

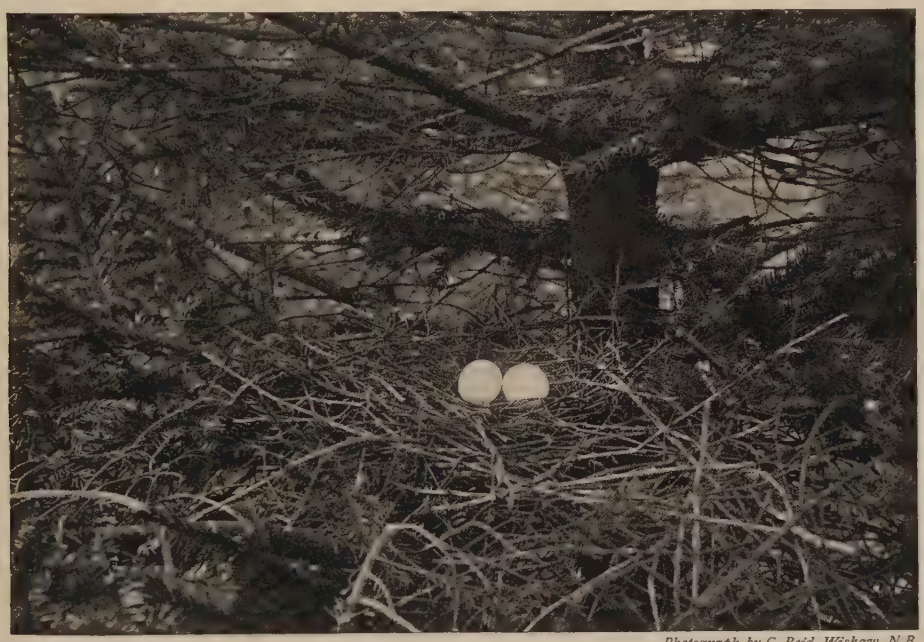
DOUGLAS ENGLISH.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE GALLINACEOUS BIRDS

WE have now arrived at the fourth great order in Linnæus's classification, which contains the gallinaceous or fowl-like birds. The Pigeons head the list, and we have four British representatives of this family — Wood Pigeon, Stock Dove, Rock Dove and Turtle Dove. The three former are residents, but the Wood Pigeon especially has its numbers greatly recruited in winter by migrants from more northern and eastern climes. The crooning Turtle Dove occurs only as a summer migrant. It is rather late in arriving, for it seldom appears before the first week in May. Its small size at once distinguishes it from its congeners, and its mournful note—"tur-tur," from which both its English and Latin specific names are derived—is somewhat suggestive of the twilight music of the toads. In flight this Dove may be recognised by its fan-shaped tail, which, at close quarters, shows white at the tips of the semi-expanded feathers. As it is especially fond of the seed of the red and white campions and corn-cockle, it may be counted as a farmer's friend.



Photograph by C. Reid, Wishaw, N.B.

WOOD PIGEON'S NEST.

The Wood Pigeon is generally known as the Ring Dove, in consequence of the conspicuous white patches on either side of its neck, which apparently form a complete circle whilst the bird is on the wing;

these, together with the white wing bars, mark it off distinctly from the smaller Rock and Stock Dove. During the prolonged breeding season—from April to September inclusive—the natural shyness

All four species of Doves lay two eggs only, and both sexes take equal shares in incubation. The eggs of all are pure white, somewhat elongated, and equally pointed at either end. The Turtle and

Photograph by J. T. Newman, Berkhampstead.

YOUNG PARTRIDGES.

of the wary Wood Pigeon wears off. In the summer, too, the dense tree foliage prevents approaching man from being so easily seen by the amber-eyed Cushat, whose peculiar nuptial flight—consisting of a series of dives, the bird alternately rising and falling voluptuously through the air—may then frequently be witnessed. The bird is much persecuted in consequence of the great damage done by flocks of this voracious feeder to ripening grain, swede tops, and young clover plants.

The only redeeming features about the Wood Pigeon from an economic point of view, that I am aware of, are, that it devours the very astringent seed of the buttercup, a troublesome weed in permanent pasture, and that the abundant meat on the bird's breast—needful muscles to work its loud clapping wings—renders it an acceptable adjunct to the dinner table.

Ring Doves deposit theirs upon a cleverly, though apparently carelessly, and widely, woven platform of sticks, placed in trees or bushes at varied altitudes, according to the privacy or otherwise of the surroundings. The Stock Dove breeds in holes of trees and ruins, and also in deserted rabbit-burrows, whilst the rarer Rock Dove, as its name suggests, inhabits rocky coast land caves, never even condescending to perch on trees. The chief distinctive marks in the two similar-sized Doves last mentioned are as follows—the Stock Dove has the rump, as well as the back, blue, and one black wing bar only, whilst the Rock Dove has a white rump and two black alar bars.

The foreign Pheasant, probably introduced by the Romans, has been with us long enough to win a place upon the British list, and even without the aid of artificial rearing it sufficiently maintains

Photograph by C. Reid, Wishaw, N.B.

PHEASANTS.

its numbers, in broken country, to be classed amongst the common residents. If, however, the game laws were repealed it is probable that its size and tastiness would soon tend to its extinction, in spite of its hardiness, and the marvellous manner in which the very highly coloured male bird can manage to escape destruction in unpreserved districts. The latter is the more extraordinary in view of the self-advertisement of his whereabouts during the breeding season by his constant crowing, and as frequent wing clapping. The latter vibrating sound is made after, instead of previous to, the crow, as is the custom of our barn-door Chanticleer.

Photograph by C. Reid, Wicklow, N.B.

RED GROUSE.

Although the Red Grouse is absent from most counties in the United Kingdom, it would be unfair to omit any mention here of our only real British bird, in the exclusive sense of the term. Nowhere else in the world is he to be found wild, and is it not a great annual question, as to whether or no Parliament should rise in time to watch and help to stay the bird's flurried flight upon the far-famed "twelfth"? The larger species of Grouse, the Black Cock and Grey Hen, as the sexes are severally called, is perhaps more widely spread throughout the kingdom, but nowhere in such numbers, as the more protectively coloured bird of the heather already mentioned. The latter is more of a lowland bird than the Red Grouse, just as the winter white Ptarmigan is a constant denizen of the highest mountain tops. During the summer season the latter bird is granite-coloured and beautifully vermiculated, and equally suitably clad to escape observation as in the winter. Its plumage assimilates closely with the prevailing hues of its surroundings, which are, when the snow has melted, sparsely covered with lichen-grey vegetation and the brown-green tips of the young heather, upon which each species of Grouse delights to feed.

The difference in general plumage between the English or Grey Partridge, and the so-called French, or red-legged bird, is so distinct that there is no need to say more than that the latter has a uniform reddish brown back, and its wings are flanked with very pale lilac-coloured feathers, which are widely barred with deep chocolate. The upper part of the native species is beautifully decorated with various shades of brown, and the neck and chest are grey with black ver-

miculations. The deep chestnut horse-shoe on the breast of the adult bird must not be depended upon as a sure sexual distinction; the coloration of the wing coverts is a more certain guide, for this includes longitudinal markings in the male, but barred markings in the female. In the young birds the beak is dark brown, but this fades into pale olive brown with age. The legs are at first pale yellow; they then deepen into brown and fade into slaty grey.

Until full plumage is entirely assumed, by about the beginning of November, birds of the year may be recognised by the fact that the base of the third long wing feather (the last to be moulted) is still supple and soft, whilst in old birds the entire quill is stiff and hard. The male Frenchman has horny knobs in place of spurs, and the larger these excrescences are the older and, when full-grown, the tougher he will be. Young birds of this species are only to be distinguished from their parents by the fact that they are less highly-coloured; the black and white of the gorget is less distinctly marked. In the first feathering the young birds are loosely feathered, and ragged in appearance, while the cinerous brown of the upper plumage is splashed with lighter markings.

The two species, when disturbed *en famille*, rise differently. A covey of English birds generally leave the ground almost simultaneously and settle again together, whilst the more crafty and running Frenchmen take wing much more independently, and frequently alight far apart from one another. And a fine chuckling the old cock bird frequently makes in calling his scattered family together when danger disappears!

MAURICE C. H. BIRD.

PHEASANT AND NEST.

THE STORY OF A WASP'S NEST

By JOHN J. WARD, F.E.S.

Author of "Some Nature Biographies," "Peeps into Nature's Ways," etc.

With Photographs by FRANCES PITT

WHEN the cold nights and mornings commence, trouble falls upon the wasps' community. Over that thriving city with its thousands of inhabitants there literally comes a frost, a "killing frost" as Shakespeare puts it, and then we may paraphrase from Wolsey's famous speech and say of that populous city, "Farewell, a long farewell, to all thy greatness!"

ENTRANCE HOLE TO A NEST OF THE COMMON WASP.
The nest itself is shown on the opposite page.

From that hour things go wrong with the busy throng. No longer is there a continual traffic in and out through the gateway, the only entrance to the city. Only occasionally will a worker crawl feebly out, and even then, instead of the characteristic hurried flight, as on business bent, it probably comes to rest near the entrance at any spot where the warm rays of the sun penetrate. Even the sentinel at the gate will now permit a mischievous wood-louse to pass slowly by her and enter that stronghold which has been so long and bravely held against all comers.

Within the city things are even worse, for many of the workers have not returned, and this alone, in a community where every individual has his specific work to perform, is enough completely to disorganise matters. Here, for example, are hungry grubs, or larvæ, that need feeding; there, certain repairs are urgent, the neglect of which threatens danger to the frail structure of the home; but, worst of all, those remaining in the city make no attempt to meet the emergency. Under normal conditions, by an extraordinary effort on the part of every individual, the difficulty would have been met, but now it is different; the inhabitants are content to rest sluggishly amongst the cells—for they have lost heart.

This sharp and sudden frost is not alone

responsible for the catastrophe. The blow commenced to fall many days before, when one night some of the worker Wasps alarmed their relatives by crawling into their quarters much earlier than usual, numbed and cold. When inside the nest they quickly revived, but it was a bad omen! Whether the fact of this misfortune to some of the workers was communicated to the Wasp queen I am quite unable to say, but certainly her behaviour became quite different after that shock.

Previously, she had always deposited eggs which ultimately produced workers, or neuters, which are really imperfect females; the queen herself is the only perfect female in her community. Consequently, the business of egg-depositing rests entirely with her; and it was in this direction that her behaviour changed. She commenced to lay eggs which hatched out grubs that eventually developed into perfect females like herself. Whether the eggs were actually different, is a matter that I cannot here debate; it may be that the after feeding of the young grub brought about the change.

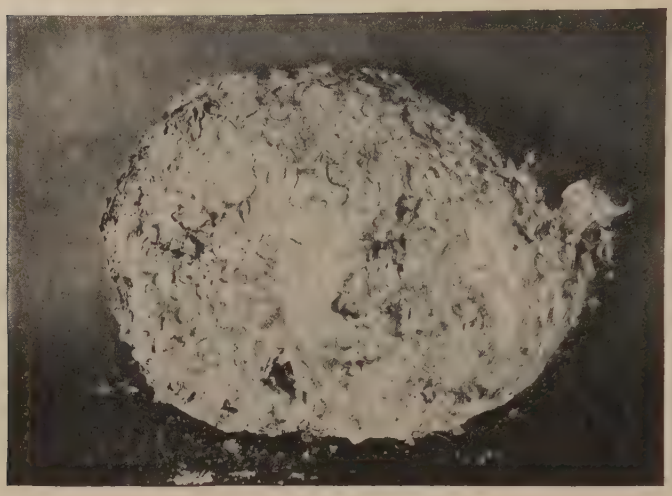
Later on, it frequently occurred that some of the workers became numbed as night drew on, and in the early morning they got later and later in leaving the nest. At this time, too, the queen Wasp again changed her ways. From her eggs now appeared a brood of males. It was several days after this brood of males, or drones, had been hatched when that "killing frost" overtook the Wasp city, and brought such dire distress to its inhabitants.

The blow had fallen, and for the moment the once busy city had come to a standstill. Later in the day, when the warm sun made its declining heat felt, the Wasps within the nest began, one after another, to arouse themselves; and it quickly became evident that something unusual was taking place.

The last broods of males and perfect females, or young queens, were making their way out of the nest. Until now, the latter had lived amicably with their mother and the workers within, and they appeared to do no work. At all events, they did not fly in and out of the nest to gather materials either for food or building purposes. Likewise with the fat-bodied drones. They were even less productive members of the community, for their only function was that of becoming fathers to the generation of the future, and by early winter every one of them will have perished from cold. On the young queens, however, depends the future of the race.

NEST OF THE COMMON WASP *IN SITU*, WHEN THE SOIL HAS BEEN REMOVED.

Now both the drones and the young queens were leaving their home. The remaining workers gave no heed to them. Instead they were busy with the white grubs they had fed and tended with so



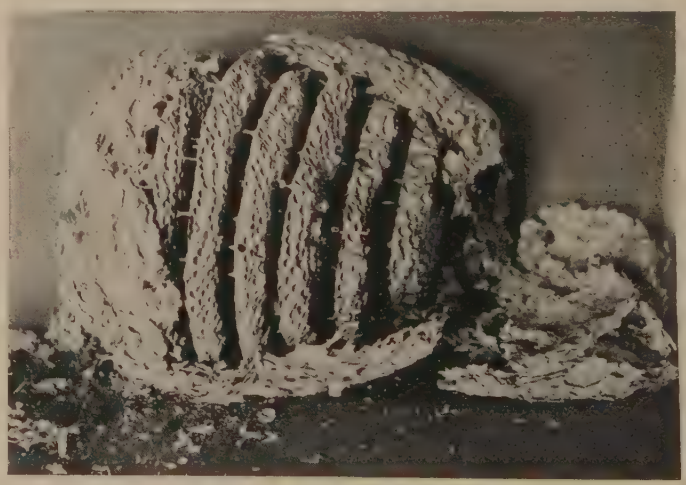
SIDE VIEW OF NEST.

much jealous care; but no longer were they feeding them. They were now ruthlessly dragging them from their cradles, one by one, and carrying them outside the nest, where they left them to perish. Apparently they recognised the futility of attempting to rear them, and, rather than let their charges slowly die of starvation, they subjected them to exposure, so that their end should come quickly. After this work is performed, those workers who have carried out this last function, take no further interest in the fallen city, but wander aimlessly about until wet and cold brings death to them.

So the vast city becomes a ruin, and its five thousand or more scattered inhabitants terminate their existence, all excepting, perhaps, three or four of the young queens; for most of them also eventually succumb to the Wasp's arch enemy, frost. The old queen, although she leaves the nest with the young queens, naturally stands less chance of surviving; especially is this so if the city that she founded has been a large one, and her resources have been largely drawn upon. Only occasionally when a nest is broken up in mid-season by a storm or other untoward agency, does the queen survive to give origin to another nest, for then her productive powers have not become exhausted.

Our purpose now must be to see what becomes of the three or four surviving fertilised queens, for, as I have previously stated, out of that vast cityful only these remain to carry on their species to succeeding generations.

After the mating the male Wasps soon perish, and the queens of the future generations seek shelter in the crevices of walls, or amongst rubbish heaps; indeed, any dry situation, where they are well protected from the cold winds and frost, provides suitable quarters in which to hibernate. Should the young queen, however, once become exposed during the cold period, she rarely has the strength to find a new hiding place, but lies inactive until cold, or perhaps a hungry bird, abruptly terminates her career. And we should remember that, with her death, has also died the hopes of the colony



SIDE VIEW OF NEST WITH THE PAPER COVER REMOVED, SHOWING THE COMBS AND THEIR CELLS.

INSECT LIFE

TRANSPARENT-WINGED INSECTS

Specimens required :—Dragon Fly, Wasp, Bee, Gnat

Type :—Bee

Structure

Note three divisions characteristic of insect structure :—

Head.—Eyes, antennae. Note functions.

Thorax.—Bearing two pairs of membranous wings and three pairs of legs. Note structure of legs.

Abdomen.—In segments. Note sting and defensive function.

Habits

Gregarious nature. Honey seekers. Note their highly intelligent habits. Correlate with fertilisation of flowers by insects.

General

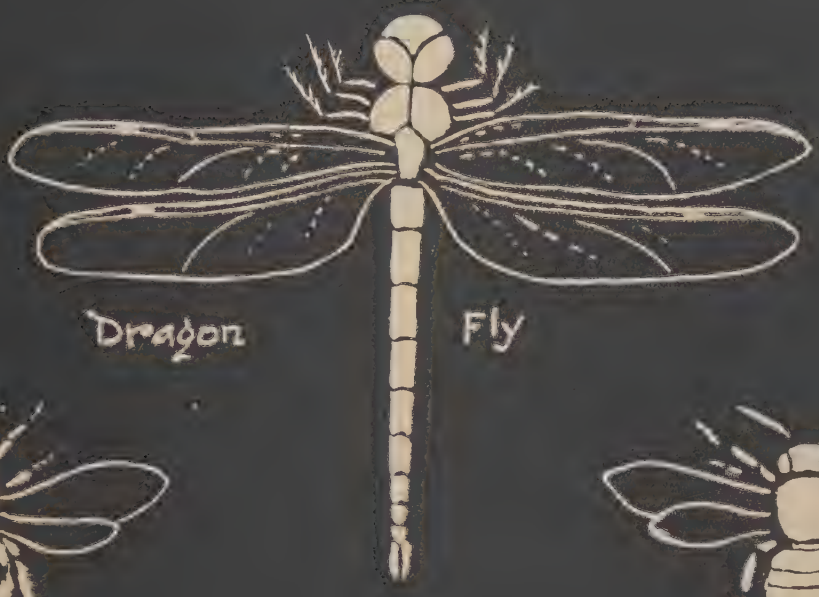
1. Life history is well illustrated by Dragon Fly, whose larvae and pupae may be taken from ponds. (Note protective resemblance of larva of Caddis Fly.)

2. Note carnivorous habit of Wasp and its nest-making power.

Study in similar way the structure of Hornet, Wasp, Dragon Fly, and Ant.

Note.—The life history of this class of insects may be studied in detail in most stagnant ponds during May. Probably the best hunting ground is a water tank. Here may be observed the Gnat's raft of eggs, the wriggling larvae, and the pupae. Numbers of Gnats may be seen escaping from the pupae cases, and the latter may be collected and preserved in spirit. In August the emergence of the Dragon Fly from the pupa case may be observed on the banks of ponds and streams. The pupa case or nymph case may be found in August and September clinging to the reeds and rushes on the sides of ponds and ditches.

TRANSPARENT WINGED INSECTS



Dragon Fly

Humble Bee

Leaf cutter Bee

Leaf cut by Bee.

Hornet

Wood Ant.

Worker ant.

which she was to found. In short, we may say that with her die five, ten, or fifteen thousand Wasps (the number depends largely on the species to which she belongs); for had she lived, and her colony flourished, its population might have reached such numbers. This, too, is why fruit-growers frequently offer rewards in early spring for each queen Wasp—it is not the queen that they are anxious to buy, but her possible progeny.

END VIEW OF THE NEST SHOWING THE FRONTS OF THE COMBS.

Now it is a sunny morning in early May. All has gone well with the dormant queen; she has safely slept away the winter months, and now she is basking on the warm wall between whose rough stones she has hidden. Presently, she commences by means of her legs to clean up her wings, and smooth down the scattered hairs that clothe her body; then she briskly brushes her face. Finally, she draws each of her antennæ, or feelers, one at a time, between her folded legs, so cleaning them from base to tip. Her toilet is then complete, and for a moment she rests. Then suddenly she rises on her wings, and at that moment begins the work of building a Wasp city.

She passes slowly along, stopping every few minutes briefly to examine every ditch, bank, stone wall, and hollow tree. At last she arrives at a little, dark opening in the bank about an inch in diameter. This opening was, formerly, the main entrance to the place where a pair of field mice reared their family and kept a treasury of nuts and seeds of various kinds, but now it is deserted. It seems, however, to possess great attractions for this mother of the coming Wasp community. She carefully pushes out bits of the soil around the entrance; pulls here and there at a dry bit of grass; finally, she disappears inside. Just what she does inside I am unable to say because the bottom of the hole is a foot deep, but I have no doubt, by the long time that she is occupied there, that she is so well pleased with her discovery of so excellent a site for operations that she forthwith proceeds to tidy up the place a bit—at all events those parts where immediate action is to take place.

Almost any day afterwards, by waiting at that hole for a longer or shorter period, one could see the Wasp going in and out. It is evident that she spends a considerable amount of time outside her retreat as well as inside. One day her visits are particularly frequent; evidently she is not going far; indeed, by watching her closely one could, on each of her journeys,

see her suddenly drop down at almost the same spot against a fence some fifty or sixty feet away. A little observation at that spot explains the purport of her regular visits.

One of the palings of the fence has become very dry, and has split in all directions. Each time the Wasp appears she alights upon this paling, and from the split edges of it, by means of her strong jaws, she tears off fibres of the wood. These fibres she then gnaws and works about until, together with the saliva which she secretes, they become a pulpy mass, which she then carries in her mandibles to her burrow.

The first few pellets so obtained are applied to a root or some projecting part in the roof of the chamber, until a stout little papier-maché pillar nearly half an inch in length is formed. To the end of this little footstalk is attached a little grey cover or cap of about half an inch in diameter, and to the underside of this are attached generally four, but sometimes three, cells. Then, in each of the cells is placed an egg. Such is the beginning of the nest, or the Wasp city. The queen, it will be observed, gathers her own building material, masticates it, and manufactures the paper for the walls of the city; then she turns architect and builder. Finally, her motherly instinct asserts itself, and she prepares the cradles for her young and deposits her eggs. Indeed, although she is designated a queen, yet in truth she is literally a maid-of-all-work.

NEST OF THE WOOD WASP ON A SYCAMORE TREE.

Other cells are quickly added at the sides of those already formed, and fresh layers of paper are laid on above, each layer being extended to cover the newly-made cells, and turned in at the bottom, so that the comb of the cells is always covered above and protected below, for each cell is attached at its base and opens mouth downwards. In the Wasp citydom everything is topsy-turvy, and, as I have already mentioned, the queen Wasp, at the very commencement of her city, lays its foundations at the roof of her burrow.

As the cells are formed, an egg is laid

WOOD WASP'S NEST ON A FIR BRANCH.
Part of the covering has been removed; only one small hole is used as entrance to the nest.

in each one. Before many cells are made, the eggs that were first deposited begin to hatch out their grubs, and then the queen has new work to attend to, for the helpless grubs within their cells have to be fed. Nevertheless, they get attended to, and, as they grow, the walls of their cells are built higher to accommodate them; and the whole of the time this overworked mother goes on gathering material and building the cells and walls of the city, not to mention the depositing of eggs in each cell as it is formed.

Later on, some of the first hatched grubs cease to feed, and spin a silken cover over the mouth of their cells. That is a glad day for the queen Wasp, for not only is she relieved of the work of feeding the grubs, but soon she will have willing assistants around her, all ready and anxious to help on the great work which she has, by her own unaided labours, commenced and carried through to such a successful issue.

After a brief period the pupating grubs bite their way through the cover of their cells. They have now developed wings; indeed they are fully-developed worker Wasps. At their advent, things grow apace. Like their mother they naturally and immediately develop building proclivities, and leave the nest to gather in wood and vegetable fibres; they return with this material masticated ready to build cells or extend the boundary walls, as the case may be. What is more remarkable, they have the same motherly instinct as the queen herself, feeding and tending the young of the continually increasing nursery; in fact, they are like their mother in every respect, excepting that under ordinary circumstances they never lay eggs.

With the increased labourers new combs or terraces of cells are formed one below the other. Little pillars are attached here and there to the connecting point of some of the cells, and to these are added three or four cells, just as in the first instance; then more cells are placed beside these by numerous workers until each

A WOOD WASP'S NEST WITH THE PAPER COVER REMOVED TO SHOW THE CELLS.

little group meets, and the complete comb is formed. In this manner are the various terraces produced, and as the cells are all arranged mouth downwards, their bases serve as stages for the workers to move about upon while they feed the developing grubs in the tiers above. With this increased production of cells, the queen can no longer assist in the work of building, or of tending the young, for her whole time is devoted to depositing eggs in the cells prepared by the workers.

The broken nest shown on pp. 368 and 369 makes the whole matter clear as to the arrangement of the cells and their suspended terraces or combs, while the illustration of the exterior of the nest on p. 368 reveals its papery covering more in detail, and shows its shelly patches, each of which is composed of numerous tiny bands of paper prepared by the many workers that built the city.

On pp. 370 and 371 are shown examples of tree building Wasps' nests, which differ from the species that build underground only in respect to the site selected for their dwelling and in minor details that need not be considered here. Indeed the story of all species of British social Wasps is much the same. Each thriving city commences with the labours of the hibernated queen; each thriving city terminates with the wreck and ruin of its wonderful fabric after the sexual generations have appeared just before winter.

JOHN J. WARD.

RUINS OF A WASP'S NEST THAT WAS SCRAPED OUT AND EATEN BY A BADGER.
Wasps' nests are esteemed a luxury by badgers.